THE WORKS OF Dr. *Archibald Pitcairn*;

Wherein are Diſcovered
The True *Foundation* and *Principles*
OF THE
ART of PHYSIC:
With CASES and OBSERVATIONS
Upon moſt *Diſtempers* and *Medicines*.

Done from the *Latin* Original.

With ſome Account of the AUTHOR'S LIFE, *prefixed.*

There is alſo added,
His Method of Curing the SMALL-POX,
Written in the Year 1704. for the Uſe of the Noble
and Honourable Family of *MARCH*.

LONDON:
Printed for *E. CURLL*, at the *Dial* and *Bible*,
J. PEMBERTON, at the *Buck* and *Sun*, both againſt St. *Dunſtan's* Church in *Fleetſtreet*; and *W. TAYLOR*, at the *Ship* in *Pater-noſter-row*. 1715. *Pr.* 5 s.

30 MAR 74

PREFACE

BY A

FRIEND

OF THE

AUTHOR's.

A*S theſe* DISSERTATIONS *were the only Performances in* PHYSICK, *which Doctor* PITCAIRN *deſign'd for the Preſs; ſo the Tranſlator has ſtrictly confin'd* *himſelf to them, forbearing to meddle with ſome other Pieces handed about in Manuſcript, becauſe he is well aſſur'd the Author never intended to make them publick, moſt of them being no other than Extemporary Diſcourſes taken from his Mouth by Young Gentlemen, who ſtudied Phyſick under his Direction, when Profeſſor at* Leyden.

It was thought fit to leave out Doctor BOWER'*s Epiſtle ſubjoin'd to the* Latin *Copy; not only becauſe the Publiſher was reſolv'd to preſent his* Engliſh *Reader with nothing but what was ſtrictly Doctor* PITCAIRN'*s own Work; but*

but chiefly becauſe it ſeem'd the leſs needful, that his Diſſertation upon the Motion which reduces the Aliment in the Stomach to a Form proper for the Supply of the Blood, *is ſo very full upon the ſame Subject.*

The Matter in ſhort is this: Our Author in that Diſſertation attributes the Digeſtion of the Aliment chiefly to the *Action* and *Motions* of the *Stomach* and other neighbouring Muſcles. *Doctor* HECQUET, *a Phyſician at* Paris, *in a ſmall Tract, lately eſpous'd and maintain'd the ſame Notion. And Doctor* ASTRUC *of* Montpellier *wrote a little Piece upon this* *Sub-*

Subject, principally againſt Doctor HECQUET, *contending*, That the Digeſtion was made, not chiefly by Attrition, but by proper Juices diſſolving the Meat by way of Ferment. *And Doctor* BOWER'*s Epiſtle was intended for an Anſwer to Doctor* ASTRUC, *before it was known that Doctor* HECQUET *had made a proper Defence for himſelf. But the* Engliſh *Reader will be at no loſs for any or all of theſe Pieces, if he carefully conſiders our Author's own Diſſertation, wherein he will find the Subſtance of almoſt all that has been ſaid upon either Side of the Queſtion; but notwithſtanding, if the*

the Curious deſire we may afterwards have an Opportunity to oblige them with the whole Controverſy as ſoon as the French *Tracts beforemention'd come to hand.*

Advertiſement.

THE Reader is deſir'd to correct this Miſtake, *viz.* throughout the *Diſſertation* beginning at *Page* 61, and ending at *Page* 101. for *Gravity of the Blood*, read *Quantity of the Blood.*

Some ACCOUNT *of* Dr. PITCAIRN.

THE AUTHOR of theſe *Diſſertations* was one of the Firſt who leaving the Old conjectural Method of Phyſical Writers, ſtruck into a New and more ſolid Way of Reaſoning, grounded upon Obſervations and Mathematical Principles.

He ſtudied many Years abroad, where his great Learning, and ſucceſsful Practice procured him the Eſteem of all Foreigners, and ſpread his Reputation into as many different Countries as the Variety of Students of Phyſic in *Holland* owed their Birth to, every one carrying home a high Opinion of Dr. PITCAIRN's uſeful Knowledge in that Science.

Theſe Qualifications in his Art raiſed him in a little time to the Profeſſorſhip at *Leyden*, unto which he was choſe in the

Adverti∫ement.

THE Reader is deſir'd to correct this Miſtake, *viz.* throughout the *Diſſertation* beginning at *Page* 61, and ending at *Page* 101. for *Gravity of the Blood*, read *Quantity of the Blood*.

Some ACCOUNT *of* Dr. PITCAIRN.

THE AUTHOR of theſe *Diſſertations* was one of the Firſt who leaving the Old conjectural Method of Phyſical Writers, ſtruck into a New and more ſolid Way of Reaſoning, grounded upon Obſervations and Mathematical Principles.

He ſtudied many Years abroad, where his great Learning, and ſucceſsful Practice procured him the Eſteem of all Foreigners, and ſpread his Reputation into as many different Countries as the Variety of Students of Phyſic in *Holland* owed their Birth to, every one carrying home a high Opinion of Dr. PITCAIRN's uſeful Knowledge in that Science.

Theſe Qualifications in his Art raiſed him in a little time to the Profeſſorſhip at *Leyden*, unto which he was choſe in the Year 1691, as much to the Reputation of the *Scottiſh Nation* as his own. Here he began his excellent Lectures in a Manner which confirmed his Auditors in the juſt Notions they had conceived of him, as of one who was to baniſh the Old falſe Maxims of Phyſic, and lay more certain and infallible Fundamentals of the moſt comprehenſive Art the Mind of Man is capable of attaining. It were needleſs to inform the Reader what Errors he reformed, what new Lights he ſpread over the Face of Phyſic, and what admirable Hints he gave for its future Improvement, ſuch as the Genius of a ſecond PITCAIRN, or a preſent MEAD, might indeed carry to that deſirable Pitch which other Learned Men have hitherto laboured at in vain. There is no Page in theſe Diſſertations wherein ſomething of this Nature may not be obſerved, and the Book it ſelf will be the beſt Evidence of the Truth we aſſert.

He continued in the Chair at *Leyden* ſometime, and publiſhed a great many of the following Pieces in that Place, all which were admired by the Learned of the Faculty; and tho' ſome of his Opinions met with Adverſaries, the Doctor had no Occaſion to give himſelf the Trouble of a Vindication; the Juſtneſs of his Reaſoning raiſing him up Advocates wherever Truth prevailed over Sophiſtry, and good Senſe was preferred to the Jargon of unintelligible Terms.

He had in all Probability continued longer at this Place, but ſome private Concerns obliged him to retire into his own Country, where his Fame had already made Way for an honourable Entertainment among all Perſons of the beſt Senſe and Quality. Here he continued his Practice with equal Applauſe and Succeſs, keeping at the ſame time a Correſpondence with moſt of the great Men of the Faculty in all Parts of *Europe*, whom either his Writings or Converſation at *Leyden* had made his Friends and Admirers. Indeed he was the freeſt and moſt communicative of his Advice of any Perſon perhaps that ever made ſo eminent a Figure in his Profeſſion, never refuſing either to ſatisfy by Letter the Curioſity, or inform the Mind of the Enquirer. His Friendſhip with the great BELLINI, and Monſ. HECQUET, muſt never be forgotten: and it is evident from their Writings, that they ſeemed to be proud of that Name, and took all Occaſions to do Juſtice to the Merit of their Friend.

This may lead us into ſome part of his private Character, of which there are too many Witneſſes living to make us ſay any thing but ſtrict Truth.

In the Buſineſs of his Profeſſion he was always ready to ſerve every one to the utmoſt of his Power, and even to contribute to their Health at the Danger of his own. He was a Man of too good Senſe to be a Humouriſt in Phyſic, or refuſe Attendance out of Pique, or Prejudice, or Affectation: He underſtood the Value of Life too well to ſacrifice it to Caprice and Humour. There is one thing more remarkable of him, that he was not at all concerned about Fees, and frighted from his Duty by the Sight of Poverty in his Patient; nay he went with greater

Cheerfulneſs to thoſe from whom he could expect nothing but good Will, than to Perſons of the higheſt Condition. Beſides, in Caſes which ſeemed to require that Aſſiſtance, he not only gave away his Skill and Medicines, but extended his Generoſity for the Proviſion of other Conveniences for the Sick, and left the Marks of his Charity, as well as of the Liberality of his Art, behind him. The Virtue of Charity was really ſo much his own in the Uſe of it, that he contrived a moſt ſecret and decent manner of conveying his Benevolence, and relieved many who knew not their Benefactor.

In ſhort, he was one of the greateſt and moſt uſeful Men in his Profeſſion this Age has produced; of a free and univerſal Genius; a good Orator, Poet and Philoſopher. He was of a pleaſant, engaging Humour. Life ſat very eaſy upon him, in all its Circumſtances. He deſpiſed many, but hated none. He loved his Friends, and laughed at his Enemies. Thus he drew out Life to above ſixty Years. And it was not long before he

Died that he gave us that excellent Picture of himſelf into a Copy of Verſes, which are at leaſt equal both in their Eaſineſs, Simplicity, and Elegance of Thought and Stile, to any of CATULLUS, and far ſuperiour to any modern Compoſition of that kind. They have been printed under the Name of WALTER DANNISTON; and Mr. PRIOR honoured them with an Imitation, how near the Original the Reader may judge.

GUALTERUS DANNISTONUS

Ad AMICOS.

DUM ſtudeo fungi fallentis munere vitæ,

Adfectoque viam ſedibus Elyſiis,

Arctoâ *florens* Sophiâ, Samiiſque *ſuperbus*

Diſcipulis Animas morte carere cano.

Has ego corporibus profugas ad Sidera mitto,

Sideraque ingreſſis otia blanda dico;

Qualia conveniunt Divis, Queis fata volebant
Vitai faciles molliter ire vias,
Vinaque Cælicolis media inter gaudia libo,
Et me quid majus ſuſpicor eſſe viro.
Sed fuerint nulli, forſan, quos ſpondeo, cæli,
Nullaque ſint Ditis *Numina, nulla* Jovis;
Fabula ſit terris agitur quæ vita relictis,
Quique ſuperſtes, Homo, qui nihil eſto Deus,
Attamen eſſe hilares, & inanes mittere curas
Proderit, ac vitæ commoditate frui,
Et Feſtos agitaſſe dies, ævique fugacis
Tempora perpetuis detinuiſſe jocis.
His me parentem præceptis occupet Orcus;
Et mors ſeu Divum, ſeu nihil eſſe velit.

Nam Sophia Ars illa eſt quæ fallere ſuaviter horas

Admonet, atque orci non timuiſſe minas.

WALTER DANNISTON

To his FRIENDS.

Imitated by Mr. PRIOR.

STudious the buſy Moments to deceive,
That fleet between the Cradle and the Grave,
I credit what the *Græcian* Dictates ſay,
And *Samian* Sounds o're *Scotia*'s Hills convey.
When mortal Man reſigns his tranſient Breath,
The Body only I give o'er to Death:

The Parts diſſolv'd and broken Frame I mourn,
What came from Earth I ſee to Earth return.
The Immaterial Part, th'Ethereal Soul,
Nor can Change vanquiſh, nor can Death controul.
Glad I releaſe it from its Partner's Cares,
And bid good Angels waft it to the Stars.
Then in the flowing Bowl I drown thoſe Sighs,
Which, ſpite of Wiſdom, from our Weakneſs riſe;
The Draught to the Dead's Memory I commend,
And offer to the now Immortal Friend,
But if oppos'd to what my Thoughts approve,
Nor *Pluto*'s Rage there be, nor Pow'r of *Jove*,
On its dark ſide, if thou the Proſpect take,
Grant all forgot beyond black *Lethe*'s Lake:
In total Death ſuppoſe the Mortal lie,
No new Hereafter, nor a future Sky:

Yet bear thy Lot content, yet ceaſe to grieve;
Why, e're Death comes, doſt thou forbear to live?
The little Time thou haſt 'twixt Inſtant now
And Death's Approach, is all the Gods allow;
And of this little haſt thou ought to ſpare
To ſad Reflection, and corroding Care?
The Moments paſt, if thou art wiſe, retrieve,
With pleaſant Mem'ry of the Bliſs they gave.
The preſent Hours in preſent Mirth employ,
And bribe the future with the Hopes of Joy.
The Future, few or more, how e'er they be,
Were deſtin'd erſt, nor can by Fate's Decree
Be now cut off, betwixt the Grave and Thee.

To the Tranſlator.

SIR,

“ THERE being ſome Mi-
“ ſtakes in Dr. *Pitcairn*'s THEORY OF
“ THE DISTEMPERS
“ OF THE EYE, (*P.*
“ 25 and 26.) I have according to
“ my Promiſe ſent you the following
“ plain and eaſy Demonſtration of
“ what the Doctor means to prove.
“ This is his Propoſition in other
“ Words----

The Muſcæ volitantes, *or ſmall Bodies, like Flies or Spiders, which appear to fly or ſwim about the Air, before the Eye, are not owing to any Bodies in the* Aqueous *or any other* Humour of the Eye.

LEMMA I.

The Focus of parallel Rays, or burning Point of a Lens of Glaſs convex on both ſides, is nearer or farther behind the Lens, according as it is more or leſs convex; nearer behind the Lens, if it be more convex, or a Segment of a leſſer Sphere; and farther behind it, if the Lens be leſs convex, or a Segment of a greater Sphere.

LEMMA II.

If a diſtant Object, or ſuch an one whoſe Rays falling upon a Lens are look'd upon as parallel, has its Image diſtinctly projected behind the Lens in its Focus, which is at a determinate Diſtance, as for Example, at the Diſtance of an Inch; by bringing the Object pretty near the Glaſs, the Focus will fly off to a greater Diſtance, that is, the Image will be projected farther behind the Glaſs than the fore-mentioned Diſtance; but if we would have the Image reſtor'd to the Diſtance of an Inch, the Object remaining ſtill *near the Glaſs, we muſt ſubſtitute another Lens more convex in a due Proportion, (whoſe Focus of parallel Rays is ſhorter than that of the former Lens) and the Image will be diſtinct at the Diſtance of an Inch, as before; the Focus of the near Object in this Glaſs being at the ſame Diſtance from it as the Focus of parallel Rays in the other.*

Common Experiments, and the leaſt Tincture in Optics, will prove the Truth of the Lemma's.

The Rays which coming from a diſtant viſible Object fall upon the *Cornea* of an Eye, are by the Coats and Humours of the ſaid Eye refracted ſo as to unite upon the *Retina* of it, and there project the Image of the ſaid Object, the Eye doing the Office of a convex Lens: Now, if the Object be brought nearer to the Eye, as for Example, to the Diſtance of two or three Feet, and all the Parts of the Eye remain in the ſame Poſition, and of the ſame Figure as before, the Rays will be intercepted by the *Retina*, before they can project a diſtinct Image of the Object by their Meeting, which (could they paſs on) would be behind the *Retina* by *Lemma* 2. But the Eye being made of flexible Coats, and yielding Humours, has the Power to alter its Figure, and become more convex, and ſo by that Means its Focus is ſhortned by *Lemma* 1. it being the ſame thing as the ſubſtituting a more convex Lens; and therefore by *Lemma* 2. the Object, tho' brought near, will paint a diſtinct Image of it ſelf on the *Retina*, and ſo the ſaid Object will be ſeen diſtinctly.

But if the Object be brought very near to the Eye, as *for Ex.* to the Diſtance of 4 Inches, it will be out of the Limits of diſtinct Viſion, and no Image will be projected on the *Retina*, the meeting Points of the refracted Rays being far beyond it; neither can they be brought to the *Retina* by making the Eye more convex, becauſe the Eye cannot be made convex enough for an Object at ſo little a diſtance; as any Body may be ſenſible of, by the Pain that is felt in endeavouring to look at ſo near an Object.

There are indeed ſome ſhort-ſighted People, whoſe Eyes are ſo convex, that they can ſee diſtinctly at that Diſtance; but if the Object be brought within half an Inch of their *Cornea*, or elſe cloſe to it, it will then be out of the Limits even of their Viſion, and no Image at all of ſuch an Object projected on the *Retina*.

If then no Object at the *Cornea*, by reaſon of its Nearneſs to the *Retina*, can be projected upon it, much leſs will any Object under the *Cornea*; that is, in the *Aqueous Humour*, or in any other Humour of the Eye. *Which was to be demonſtrated.*

The ſame thing may alſo be prov'd by two eaſy Experiments.

Expt. 1. Take a convex Lens of Glaſs, and having ſet a Candle at any

Diſtance before it, greater than that of its Focus of parallel Rays, the inverted Image of the Candle will fall upon a Paper held behind the Glaſs, and be diſtinct at a Place eaſily found by moving the Paper backward and forward; then ſtick ſeveral Pieces of Paper upon the Lens, ſo that the Places of the Lens which are cover'd take up as much of it as what is left uncovered, or more if you will; and then expoſing it to the Candle as before, you will have as diſtinct an Image as before, tho' perhaps not ſo bright. Tho' dark Bodies ſhould be within the Lens it ſelf, as it ſometimes happens if the Glaſs of which it is made be taken from the Top or Bottom of the Glaſs-houſe Pots, the Image will alſo be diſtinct.

Expt. 2. Take the *Cryſtalline Humour* of an Oxe's Eye, or any Eye freſh taken out of the Head, and it will project an Image of the Candle as the Lens did; and diſtinct alſo, tho' you ſtick little Pieces of Paper upon it.

From theſe Experiments it is plain, that no Bodies, in any of the Humours of the Eye, can project their Images upon the *Retina*.

There is another Proof of this, which perhaps has not been taken Notice of before, for which Reaſon I mention it, tho' it is not ſo direct as the others.

It is obſervable, that thoſe which ſee the *Muſcæ volitantes*, ſee them more when they look at a bright Object, or have been juſt looking at it, than when they look at a dark one. Now if Bodies in the *Aqueous Humour* obſtructed ſome of the Light which comes from the Object, and made *Muſcæ volitantes* by hindring it from falling on the *Retina*, it would be eaſy for the Eye to open its Pupil, (which is narroweſt when the Eye looks at a bright Object) and take in more Rays. Whereas if the *Muſcæ volitantes* appear'd more when we look at dark Objects, we could not be help'd by taking in more Rays; becauſe the Pupil is then as open as it can, in order to receive a great many Rays, which are reflected but ſparingly by dark Objects.

Now if we ſuppoſe with Dr. *Pitcairn*, that the Fault is in the *Retina*, which in ſome Parts of it is inſenſible, or not ſenſible enough to the Impulſe of the Rays, this *Phænomenon* will be eaſily explain'd; for when looking at a dark Object we ſee it by only a ſmall Impulſe on the *Retina*, the Difference between the Impreſſion on the ſound, and that on diſeas'd Parts is not ſo ſenſible; but when the *Retina* is ſtruck by a ſtrong Light, as in the firſt Caſe, we are more ſenſible that the Impreſſion of the Rays is differently receiv'd upon the *Retina* diſeas'd in ſome Parts.

" If you think this worth publiſh-
" ing, it is at your Service.

I am, Sir, your moſt humble Servant,

J. T. D.

Poſt-ſcript.

THERE are, indeed, ſome of thoſe who are troubled with the *Muſcæ Volitantes*, that are affected a different Way from what I juſt mention'd; that is, they ſee thoſe ſmall Images very much, when they look at a Dark Object, and ſcarce perceive them when they look at a bright one: But this will not take off the Force of the Argument us'd in the other Caſe. For in that, ſome Parts of the *Retina* are altogether inſenſible, (at leaſt for a time) and that happens to thoſe who have the *Muſcæ Volitantes* for a great while together; but in this Caſe the diſeaſed Parts of the *Retina* are not ſo ſtrongly affected or compreſs'd as to be altogether uncapable of thoſe Vibrations which they ought to have; but then a ſmall Light, or ſuch as is refletaking in more Rays; becauſe the Pupil is then as open as it can, in order to receive a great many Rays, which are reflected but ſparingly by dark Objects.

Now if we ſuppoſe with Dr. *Pitcairn*, that the Fault is in the *Retina*, which in ſome Parts of it is inſenſible, or not ſenſible enough to the Impulſe of the Rays, this *Phænomenon* will be eaſily explain'd; for when looking at a dark Object we ſee it by only a ſmall Impulſe on the *Retina*, the Difference between the Impreſſion on the ſound, and that on diſeas'd Parts is not ſo ſenſible; but when the *Retina* is ſtruck by a ſtrong Light, as in the firſt Caſe, we are more ſenſible that the Impreſſion of the Rays is differently receiv'd upon the *Retina* diſeas'd in ſome Parts.

" If you think this worth publiſh-
" ing, it is at your Service.

I am, Sir, your moſt humble Servant,

J. T. D.

Poſt-ſcript.

THERE are, indeed, ſome of thoſe who are troubled with the *Muſcæ Volitantes*, that are affected a different Way from what I juſt mention'd; that is, they ſee thoſe ſmall Images very much, when they look at a Dark Object, and ſcarce perceive them when they look at a bright one: But this will not take off the Force of the Argument us'd in the other Caſe. For in that, ſome Parts of the *Retina* are altogether inſenſible, (at leaſt for a time) and that happens to thoſe who have the *Muſcæ Volitantes* for a great while together; but in this Caſe the diſeaſed Parts of the *Retina* are not ſo ſtrongly affected or compreſs'd as to be altogether uncapable of thoſe Vibrations which they ought to have; but then a ſmall Light, or ſuch as is reflećted by a dark Object is not able to excite them, tho' when the Eye is turn'd to a lucid or very ſhining Object, ſo great a Quantity of Light puſhes in upon the *Retina*, as to cauſe ſufficient Vibrations in the diſeas'd as well as the ſound Part.

* * *

ERRATA.

PAGE 65. *Line* 29. *read* the Air being extracted.
P. 251. *l.* 4. *r.* Anaſarca.
P. 254. *l.* 19. *r.* Sleepy Diſeaſe, *p.* 248.

THE CONTENTS.

AN Oration proving the Profeſſion of Phyſic free from the Tyranny of any Sect of Philoſophers, Page 7.
The Theory of the Diſtempers of the Eye, P. 25.
A Diſſertation upon the Circulation of the Blood thro' the minuteſt Veſſels of the Body, P. 29.
A Diſſertation of the Cauſes of the different Quantity that the Blood flows with through the Lungs of living Creatures and Embryons, P. 61.
A Diſſertation upon the Motion which reduces the Aliment in the Stomach to a Form proper for the Supply of the Blood, P. 102.
A Solution of the Problem concerning Inventors, P. 135.
A Diſſertation upon the Circulation of the Blood in Born Animals and Embryons, P. 164.
A Diſſertation concerning the Cure of Fevers by Evacuation, P. 188.
A ſhort Diſſertation concerning the Effects of Acids and Alkalies in the Cure of Diſtempers, P. 208.

The CONTENTS.

Some Obſervations concerning Womens Monthly Courſes, P. 221.
Of the Encreaſe of the Quantity of the Blood in the Natural State, and the Proportion of that Encreaſe, P. 226.
Concerning the Ingreſs of the Diſtemper commonly call'd the Venerea Lues, *or Pox,* P. 238.
Concerning the Small-Pox, P. 244.
For the Arthridis *or Gout,* P. 247.
Of the Diviſion of Diſtempers, P. 248.
Of the Scurvy, P. 252.

TO HIS
GOD
AND HIS
PRINCE
THIS
WORK
Is Humbly Dedicated
BY
Archibald Pitcairn.

June 10, 1713.

READER,

YOU *have here my* Diſſertations, *ſome of which were never before made public.*

There is annexed to them an Epiſtle in anſwer to ASTRUCIUS *a* French-man, *written by Dr.* THOMAS BOER *a* Scots-man, *Profeſſor of Mathematics, and Doctor of Phyſic in the famous Univerſity of* Aberdeen, *whoſe Knowledge in Mathematics is as remarkable, as his Friendſhip is valuable. I take the Opportunity of inſerting in this place Dr.* JAMES GREGORY'*s Opinion upon this Diſpute, a celebrated Profeſſor of Mathematics in the Univerſity of* Edinborough. *Take it in the Words of Dr.* GREGORY *himſelf in his Letter to me.*

“ ASTRUCIUS *ſeems to me to make uſe of*
“ *ſuch a way of Arguing, as may formerly*
“ *have gained him a Reputation in the Schools*
“ *of* Sophiſts *and* Metaphyſicians.

“ *If He is in earneſt, which I can't be eaſily*
“ *induced to believe, his Judgment upon* Con-
“ traction *and* Compreſſion *is widely different*
“ *from that which Men of Senſe have ever*
“ *entertained. For He allows that all the*
“ *Parts of a Circular Fibre upon its Contracti-*
“ *on approach to the Center, and yet denies*
“ *that any Fibre preſſes upon thoſe Points,*
“ *which lie between the Fibre it ſelf, and the*
“ *Center. It is evident to me, that if a Cir-*
“ *cular Fibre be contracted into the half of its*
“ *Length, it ought to compreſs whatever lies*
“ *between it ſelf and the Center, to compreſs*
“ *it, I ſay, into the fourth part of its Space.*
“ *After* ASTRUCIUS *had taken away the*
“ *Compreſſing Powers, he ought alſo to do the*
“ *ſame by the Contracting Powers, and ſo to*
“ *prove by his Argument that there can be no*
“ *Contraction at all in a Circular Fibre.* AS-
“ TRUCIUS *would manage this Point in the*
“ *following manner.*

“ *There is no Point in the Circumference of*
“ *a Circular Fibre, but what may be drawn*
“ *with an equal Force to both its Sides (ac-*
“ *cording to the Direction of the Circumfe-*
“ *rence) but it is drawn neither from the*
“ *Center, nor to the Center, becauſe the* Arches
“ *that lie neareſt, and are infinitely ſmall,*
“ *which*

“ *which attract that Point, attract it at An-*
“ *gles, that are Rectangles in reſpect of the*
“ *Diameter. Wherefore there is no Point in*
“ *the Circumference of a Circular Fibre that*
“ *can be moved, that is, that Fibre cannot be*
“ *contracted.* Q. E. D.

“ Astrucius *has aſſumed a part of a*
“ *Circular Circumference not different from a*
“ *Right Line, which upon Contraction he makes*
“ *to be altered into a leſſer Right Line, with-*
“ *out any Tendency of deſcending to the Cen-*
“ *ter, or receding from it. But the* Geome-
“ tricians *aſſume a regular* Polygon *whoſe*
“ *Sides are Right Lines, which muſt neceſſari-*
“ *ly upon Contraction be changed into a leſſer*
“ *ſimilar* Polygon, *and by Conſequence the*
“ *Sides of it will approach nearer to the Cen-*
“ *ter in proportion to its Contraction.*

So far my Friend Dr. Gregory.

For my part, I will not call Astrucius’s *Book* Cacata Charta, *ſince* Astrucius *in my Opinion ſeems never to have gone to Stool, otherwiſe he muſt have perceived that the Muſcles of the Abdomen have a Power of* Contraction, *and* Expulſion.

If Dr. Robert Gray, *or Dr.* John Arbuthnott, *thoſe* Scots Æſculapii, *and* Hecquet *of* Paris, *that Reliever of Mankind, favour theſe* Diſſertations, *I ſhall not be at all concerned for the Judgment of any others. For* Bellini *is gone to the* Celeſtials.

Some barbarous Expreſſions, unknown in the Days of CELSUS, *have crept into theſe* Diſſertations, *ſuch as frequent Uſe, and the Poverty of the Latin Tongue have long ſince made familiar, and almoſt neceſſary to* Phyſicians.

A N

AN
ORATION

Proving

The *Profeſſion of PHYSIC* free from the Tyranny of any Sect of Philoſophers.

NO one, I preſume, will be diſpleaſed, if I who am choſen to the Profeſſorſhip of Phyſic by the Illuſtrious Adminiſtrators of this * Univerſity, ſhall freely, without being ſwayed by Favour or Prejudice, lay before my Audience the chief Reaſons, why the *Art of Phyſic* has ſo long baffled the Endeavours and Studies of ſo many Learned Perſons, and what Aſſiſtances are neceſſary to be uſed, to carry it to ſuch a deſirable Height, that the Life of Man may be placed in ſuch a Degree of Safety, as his Nature will admit of, and the Powers of Man can ſecure to his Fellow-Creature.

---

* Leyden.

This Freedom the Courſe of my Duty requires of me; this my Profeſſion has made moſt grateful, and almoſt neceſſary for me; and this famous Republic, ever moſt tenacious of Liberty, ſecures my Exercise of ſuch a Freedom from any Danger.

2. To deliver then my Thoughts without reſerve: In my Opinion the Skill of Healing ſeems to be of greater Antiquity than the Study of Philoſophy, becauſe when Men firſt began both the Study of Phyſic and Philoſophy, every one being determined to them either on the account of his Body, or his Mind, the Reaſons for Philoſophy were only caſual and accidental, but thoſe for Phyſic were perpetual. For the elder Race of Mankind maintained Life in a poor Condition, expoſed in the open Fields to the Injuries of the Weather, their firſt Suſtenance being the Products and Fruits of the Earth, their next Advancement to its Creatures the Cattel: They firſt felt the Inconveniencies of Heat and Cold, that is, they grew ſick, before they thought of providing Clothes and Houſes for themſelves. Theſe then were the firſt Diſeaſes, thoſe the firſt Remedies. Beſide, the Cattel being naturally of a ſhort

Exiſtence, and no leſs obnoxious to Diſtempers formerly, than now, induced a Neceſſity for the Knowledge of Healing; and they who applied themſelves to the Relief of them, were ſaid to relieve Man too: For he ſeems to have preſerved a Brother, who ſaved him from the Neceſſity of periſhing, even by Hunger.

But Men then at laſt addicted themſelves to Philoſophizing, when after ſome Experience of the Efficacy of Remedies, they could in ſome ſort of Security, and at leiſure, conſider the Qualities of Natural Bodies, and think of excelling the reſt of Mankind in the Powers of the Underſtanding.

3. But ſince there are good Grounds to believe, that the antient Phyſicians attributed Diſeaſes to the Anger of the Gods, and that Aſtronomy was the firſt Science that was cultivated by the elder Philoſophers, and that the Names of the Gods were at the ſame Time affixed to the Stars; it is probable that thoſe antient Phyſicians began their Enquiries with thoſe Diſtempers that generally attend upon the Changes of the Seaſons. From whence it follows, that according to the Notion of both the Antient Phyſicians and Philoſophers, the Method of Reaſoning in Phyſic ought to depend upon the ſame Principles as are of Uſe in Aſtronomy: And ſince in thoſe Days all Philoſo-

phers were of one Sect, and Medicine was elder than all Philoſophy, that Phyſic in its Infancy was not tied down and reſtrained to any Sect of Philoſophers. But I am inclined to explain this Subject by a more curious and exact Enquiry.

4. It is unfair to aſſert any thing for Truth either in the Theory, or Practice of Phyſic, which ſtands in ſuch a degree of Uncertainty, as no Man would willingly have the Security of his Property to ſtand: For no one ought to be in leſs Concern for his Life, than his Eſtate. From whence this Conſequence ariſes, that is not allowable to advance any thing into a Principle either in the Theory or Practice of Phyſic, which the Mathematicians, and Perſons who are the leaſt entangled with Prejudice call in queſtion: Becauſe no Man would willingly ſubmit to have his Affairs reduced to ſuch a Hazard, that there muſt be a neceſſity for a Diſputation, the Succeſs of which is doubtful for the Recovery of them; *but of all things Life is the moſt precious.*

From all which I draw this Conſequence, that ſuch Enquiries after Phyſical Cauſes as are generally propoſed by the Philoſophers, are entirely uſeleſs and unneceſſary to Phyſicians. For theſe are Points which the Heads and Patrons of Sects have wrangled about from the beginning of the World to our Days, and all to no purpoſe.

5. Nor ought this to ſeem ſtrange, ſince the Patrons of Sects by attempting the Knowledge of the abſolute Nature, and intimate Eſſences and Cauſes of things, without any regard to the Diſcovery of their Properties, were forced to make uſe of many *Poſtulata's*, and but few *Data's*, by which means they unavoidably fell into great Variety of Opinions. It is evident to any one who has been a little more than ordinary converſant in the Mathematics, or the Practice of Phyſic, that our Knowledge of things is confined to the Relations they bear to one another, the Laws, and their Properties, of Powers, which enable them to produce Changes in ſome things, and to become altered by other things. I ſpeak of corporeal things. Now theſe Powers, and their Laws are diſcovered by their mutual Action and Reaction upon each other. For Action and its Conſequences are thoſe *Data* that aſſiſt us in the Diſcovery of the Laws of their Powers; but a Phyſical Cauſe, and the Nature of things which the Philoſophers ſo much enquire after, is *that unknown ſomething* in things from whence they will have all its Powers and Properties derived. But that being impoſſible to be known without a prior Knowledge of its Powers, and a Diſcovery of their Laws, and no Effects being produceable but by its Powers, it follows that while they remain unknown, there can

be no Knowledge of the *Nature* of the thing; and when they are known, that Knowledge is of no Advantage. And therefore the Buſineſs of a Phyſician is to weigh and conſider the Powers of Medicines and Diſeaſes as far as they are diſcoverable by their Operations, and to reduce them to Laws; and not lay out their Time and Pains in ſearching after Phyſical Cauſes, which can never be deduced till after the Laws of their Powers are found out; and when they are found out, will be of no Service to a Phyſician.

6. It was then of no Uſe to our Predeceſſors in Phyſic, to have eſpouſed any Sect, and corrupted a Science in its own Nature above the Comprehenſion of the Vulgar, with uncertain and very often with falſe Opinions. By theſe Errors the Art of Phyſic has been hindered from attaining a deſirable Pitch of Perfection, and ſeems long ſince to be filled and overburdened with Conjectures, in the eyes of ſuch Perſons, who forget to diſtinguiſh that theſe Errors are not in the Art it ſelf, but its Profeſſors. For many being weary of the Diſputes which after ſo long a Courſe of Years even to this day, were occaſioned by ſuch Perplexities in the common Philoſophy, and obſerving neither Remedy nor End of this Confuſion, but that the Infection was ſtill ſpreading, that the Phyſicians ſtruck in with the Vulgar, and went over to a Sect; eaſily perſwaded themſelves that thoſe Principles were

not much depended upon that were founded upon ſuch uncertain and contradictory Opinions. This is what hinder'd the Improvement of Phyſic for ſo many Years, and this we muſt bid farewel to, if ever we intend to be Phyſicians, or Free, if ever we would be thought never to have been the Slaves of *Rome*, or at this time or any other, not to merit ſuch a Slavery.

7. That Art which of all others promiſes Safety and Health to Mankind, ought not in reaſon to be involved in the Conjectures and Dreams of Diſputants; for no Man of common Prudence would entruſt his Life to Him, whoſe Reaſoning ſeems falſe to the Generality, and probable but to very few. But Phyſicians ought to propoſe the Method of Aſtronomers as a Pattern for their Imitation. Theſe never take up, and adopt into their Science ſuch Opinions as are grateful to the Vulgar, or generally received by Orators; never in the Explication of the Motion of the Planets, call in the Aſſiſtance of a Romantic Hypotheſis concerning the Structure of the World, however pleaſing and plauſible, but by comparing the Obſervations which have been made at great Diſtances of Times and Places, and put together in a Method familiar to them, and uſeful to all the Phænomena of the Celeſtial Motions, and ſo compute the Powers and Force which Bodies in Motion obſerve in their Tendency

to other Bodies, either moveable, or immoveable. Let us, if we are inclined to deſerve well of the Republic of Phyſic, that is, of all Mankind, follow this excellent Rule of theirs. It is our Duty to compare the Obſervations that have been made by others, and continue to be made every where, upon Diſeaſes and their Remedies, and without any Regard to Opinions, which are nothing in compariſon to the certain Conviction of our Senſes, to collect from what uſually happens, what will, and what we are to do in that caſe.

No one now, I preſume, who is the leaſt converſant in Aſtronomy, imagines any ſtreſs to be laid on thoſe Points, which are to this inſtant puzzel'd with frivolous Diſputes, nor makes any Uſe of ſubſtantial Forms, ſubtile Matter, or the accidental Concourſe of Atoms in the Demonſtration of the Affections and Influences of the Celeſtial Motions: But the Aſtronomers being ſatisfied with the Allowances of a few *Poſtulata*, plainly ſhow that the Opinions of the *Sects* give them no Obſtruction; nor are their Demonſtrations at all diſturbed, whether ſubſtantial Forms exiſt or no, or whether there be any ſuch thing as ſubtile Matter or not in being. And do we ſtill doubt to enlarge the Boundaries of Phyſic by the ſame Arts? Neither is it unreaſonable to ſuppoſe, that leſſer Bodies, which are the Objects of Phyſical Enquiries,

quiries, are ſubject to the ſame Laws that Aſtronomers have diſcovered in the Greater. The Nature of all Bodies is certainly the ſame, and every Body is capable of being changed into the Body of another of any Kind whatſoever; and by conſequence all Bodies, of whatſoever Magnitude or Minuteneſs, are obnoxious to the common Effects of Motion, or Change. From whence it follows, that the Laws and Properties of the Fluids and Canals of Human Bodies may be defined, after we ſhall either have made more Obſervations, or compared and methodized thoſe that have been already made.

9. Any one who fairly conſiders what has been hitherto advanced, will eaſily allow, that nothing ought to be uſed as a Principle in Phyſic, which is not as certain as the Objects of our Senſes; for it is but reaſonable that the Care for the Life of Man ſhould exceed that for his Curioſity. This induces me to make ſome brief Remarks on a few Particulars, which our Predeceſſors, out of a fond Prejudice to their Favourite Sects, have admitted for Truth, and yet want the Evidence of Senſe; that others may avoid the committing of thoſe Errors, which have led ſo many Great Men out of the way; and which may almoſt all be reduced to this one: The aſſuming ſuch things as certain, which Men of the beſt Learning and leaſt Prejudice

dice diſpute as doubtful; or ſuch things, whoſe Certainty does not amount to ſo good an Evidence, as the Perception of our Senſes.

10. Our Predeceſſors borrowed from a Sect the Fear of a *Vacuum*, *Occult Qualities*, *the Power of Attraction* uncorrected by any Laws of Acting, and transferred them into the Art of Phyſic, and endeavoured to impoſe upon themſelves and others by this *Axiom*, that the *Phyſician begins where the Naturaliſt ends*; which, when ſpoke of the Patron of a Sect, is always falſe. Miſerable muſt the View of our Republic appear in thoſe Days, when all was over-grown and choaked with Perplexities of Words, and Things. Men of Parts and Genius were obliged to ſubmit to a Tyranny over their Reaſon, and bear the moſt inſolent internal Slavery, to give up a vaſt Stock of Human Literature, the Toils of long and ſevere Studies, to be corrupted and debauched by the Leaders of *Sects*, and thoſe Heroes were compelled to deliver their Names to be obliterated with thoſe of Sophiſts, who might have merited the Glory of an eternal Memory, for their Care in preſerving their Fellow-Citizens.

11. But however miſerable the Condition of Phyſicians may appear at that time, yet is not the Happineſs of our Age ſo great, as to make us extol our ſelves ſo very much above our Predeceſſors. After ſo great Improvements in Botany, and Anatomy, and the

Appearance of a new Face of Things in ſo many other Arts, we ſtill find the old Standard of Phyſic prevail every where. Our Anceſtors were blam'd for introducing a heap of Jargon into our Art, of Things unknown to our Senſes, and conſiſting entirely of Conjectures, and in one Word, for too great a Fondneſs to *Sects* of Philoſophy: We who have ſhook off this Weight of Stupidity, have even we been much more ſucceſsful in the Improvement of our Science? Not at all. But after that Plague, which a Flood of Barbarians had brought upon us for the Deſtruction of Letters, was diſperſed by an incredible Happineſs, and the bright Genius of ſome Men had advanced the Affairs of Phyſic to a better Condition, when nothing remained but that we might reaſonably have hoped for from the Diſcovery of the Circulation of the Blood; yet was the Succeſs which was due to this Diſcovery, prevented by a Partiality to a Sect; and thus was this Age envied a Joy neareſt to the higheſt Mankind ever knew ſince their Original.

12. I have often wonder'd how ſo many Learned and Ingenious Men, who could point out the Errors of their Predeceſſors to be avoided by others, yet could not themſelves avoid falling into theſe very Miſtakes. Let them bear the Honour of baniſhing occult Qualities, of ſubduing the idle Fears of

a *Vacuum*, and the noiſy Jargon of ſubſtantial Forms: But yet they have introduced occult Fermentations, and Pores that are obedient to the *Word of Command*; and their impotent Wiſhes, rather than their honeſt Studies for Improvement, have brought things to that paſs, that we long ſince have been at a loſs for Phyſic in the midſt of Phyſic it ſelf. For what difference, I pray, can we make between unknown Figures and occult Qualities? Or what between the Influences of the Stars, and the Operations of ſubtile Matter? Which reflects moſt Diſhonour on our Profeſſion, to allow the Veſſels a Power of attracting ſome Liquors, or when we can't ſolve the Difficulty by any other Means, to aſſume a Power to our ſelves of Poetical Machinary, and introducing Fluids exactly adapted to the Orifice of the Veſſels? Which Hypotheſis of the Fear of a *Vacuum* performs moſt Wonders for a Sect of Men; His, which gives a Liberty to any body of running in to prevent a Vacuity in any Place; or His, who has filled the World with a ſubtile Matter, which does all that Work by it ſelf, and which is infinitely minuter than all other Bodies? Who that has rejected the Sympathy and Antipathy of the Antients, can bear to hear Men diſpute of the Contention and Agreement of two different Airs that meet within the Canals of our Bodies? Who does not plainly ſee that the Natural, and the Foreign Air perform the ſame Feats as the Innate and Adventitious Heats; and that the ſame Tale is told over again only in other Words? But I am weary of inſiſting ſo long upon ſo evident a Truth. This one thing I ſhall not ſcruple to add, That I can prove that there is no Fermentation in the Glands of a Human Body, that all the Pores and all the Orifices are of a ſimilar Figure, and therefore that the Diverſity of Figures, and Ferments introduced by the Adherents of a Sect, is of no manner of Uſe in the Theory or Practice of Phyſic.

13. It remains then that we cultivate Phyſic not under the Diſguiſe of ſuch Fictions as theſe, but upon the Trials of Experience, that we ſuffer not our ſelves to be in the leaſt inſtance diverted from Truth by an unwary Partiality to a Sect, nor the Honour of our Profeſſion lie at the Mercy of the Vulgar, and be governed by their Deciſions: But let us at laſt exert our ſelves into Liberty, and let the infamous Mark of *Uncertainty* ever flowing from a Fondneſs to a Sect, be at laſt wiped off and removed from our Profeſſion.

But ſince I have affirmed that the Enquiry into Phyſical Cauſes is unneceſſary to Phyſicians, and that Aſſertion may ſeem harſh, and rude to Philoſophers, I have a mind to confirm and illuſtrate it by an Inſtance that will place this Matter beyond the hazard of Doubt, or Diſpute.

14. The Phyſicians who have wrote before us upon thoſe Diſeaſes of the Eyes, in which there are ſome Images that diſturb the Sight, make no Scruple of aſſigning a Phyſical Cauſe for it, which is the Corpuſcles that ſwim in the watry Humour, which bring in an uncertain Motion and Floating to all Parts, imprint upon the *Retina* the Images of Flies and other things that ſeem to ſwim at random before the Eyes. But while theſe People are tracing Mechanical Cauſes from their firſt Original, and ſearching after the latent Nature of theſe Affections, they have neither found out the Cauſe they ſearched for, nor aſſigned their proper Symptoms to each particular Diſtemper.

15. To make this plain, I affirm that no Corpuſcles ſwimming in the watry Humour, or encloſed within the Eye, can paint any Image of themſelves upon the *Retina*; the Proof of which is to be drawn from what is demonſtrated by Writers of Optics.

For any one who conſiders carefully how very ſmall Diameters of the Humours of the Eye muſt be aſſumed, and what the Laws of Refraction are, will eaſily find that the Images of Things placed before the *Retina* in the Eye, are projected wholly without the Eye, and are never imprinted upon the *Retina*, and therefore can never diſturb the Sight.

But to confute the Notion of theſe Images, and prove that the Corpuſcles contained either in the Aqueous or Vitreous Humour, or ſituated before the *Retina* in any part of the Eye, neither produce theſe Images by obſcuring the Parts of the Object, nor intercepting the Rays emitted by the Object, let us remember this Axiom in Optics.

" That there is no Point of a viſible Ob-
" ject from which the Rays of Light do not
" reach to all Points of the *Cornea*, and by
" Conſequence altho' many Parts of the
" *Cornea* may be obſcured, yet all the Parts
" of the Object will be ſeen by the Eye.

But if that Point of the *Retina*, in which the Rays emitted from any viſible Point ought to meet, be by any means ſo covered, and compreſſed, as to make its Poſition unfit to reflect the Image, then there can be no Perception of the Object. And if this Caſe happens in many Points of the *Retina*, all thoſe Accidents will follow which Phyſicians have ſo long fancied to be effected within the Aqueous Humour. But I will briefly explain the way, for there are more than one, how theſe Phænomena may conſtantly happen.

16. Every one knows that what we call the *Retina*, is a ſort of Net-work, whoſe Texture conſiſts of a great Number of Fibres of the Optic Nerve, whence theſe Fibres attended by the Blood-Veſſels are diſperſed

round the bottom of the Eye, and that part of the Eye that lies about the Inſertion of the Optic Nerve abounds moſt with theſe Veſſels. Therefore if the Eye is placed in ſuch a Situation, as to make the Rays neceſſarily fall upon that Part of the *Retina*, no Repreſentation or Perception of that Object can follow. We will try the truth of this *Phænomenon* thus. If any two Bodies are expoſed to View in the ſame Line parallel to the Horizon, and on a Plane that paſſes thro' the Eyes a little higher, and at the diſtance of half a Foot from each other: Then ſuppoſe the Left Eye ſhut, and the Right one turned to the Object placed upon the Left Hand; and then let us approach the Objects ſlowly, or recede from them, according as the Nature of our Eyes requires. Firſt we ſhall perceive that we ſee both Objects diſtinctly, but at laſt we ſhall come to ſuch a Point, when the Object placed upon the Right Hand will diſappear, and yet we ſhall have a clear View of all things round it. Now this Caſe happens at that Diſtance from the Objects, and in that Situation of the Eye, from the Rays falling upon that Part of the Bottom of the Eye, which is ſo obſcured and oppreſſed by its Reception of the Optic Nerve and the Blood-Veſſels, as to allow no free Room for the Impreſſion of the Image. And in Diſtempers of this Nature, other *Phænomenas* happen after the ſame manner. What makes me more poſitive in this Aſſertion, are ſome Theorems which are of uſe in the explaining the Circulation of the Blood, I have ſelected the following one, which is applicable to the preſent Caſe.

If the ſame *Phænomenon* may ariſe either from the Liquors flowing within the Veſſels, or thoſe without; it ought always to be aſcribed to the internal, never ſolely to the external Fluid. But my Aſſumption is, that there is no external Force.

17. Thus then I have produced an Inſtance of Diſtempers that are not to be accounted for by a Phyſical Cauſe; ſo that it is evident that Phyſicians may know the State of the Part affected, and the Method of Cure, without the Knowledge of thoſe Cauſes. For my part, I am ſatisfied with the Illuſtration of any one Property only of Diſeaſes, which may be of uſe in explaining their *Phænomenas*, not pretending ſo much as to gueſs at a Phyſical Reaſon, being ſufficiently aſſured no Man living is Maſter of one: For no one will attempt the giving a Phyſical Cauſe, or a Mechanical Origin for the exciting that Change, which is a Property of the Mind, when Objects propagate Motion by the Mediation of the Nerves.

But however, tho' I know, nor am at all ſurprized, that the Phyſical Cauſes of theſe Symptoms, and their intimate Natures, ſhould eſcape the diligent Enquiry of Phyſicians,

ſicians, yet I think I have explain'd either their Mathematical or Medical Cauſes, that is, ſuch as are moſt uſeful for a Phyſician to know.

I wiſh it were in my Power to give as eaſy and plain an Explication of all the other Affections of our Bodies, and deliver a Method for their Cure. Could I do this, I ſhould not deſpair of making ſome Returns to thoſe Illuſtrious and Learned Governours, who have promoted me to the Profeſſorſhip of Phyſic in that Republic, that has freed its Members from the moſt inſufferable of all Slaveries, the Tyranny of a Sect.

* * *

THE

THE

THEORY

OF THE

Diſtempers of the Eye.

EVERY one who underſtands that Part of Geometry which treats of Viſion, knows, that the *Focus* of the Parallel Rays falling from the aqueous Humour upon the *Sphæra Vitrea*, after their Refraction made at the Convex Superficies of the Sphere; is diſtant from the Vertex of the Incidence nine Semidiameters of the Sphere: and that the *Focus* of the ſame Rays, after their Emerſion from the Sphere, is diſtant from the Sphere three Semidiameters and a half. Wherefore the Rays that are parallel in the aqueous Humour, after their Refraction at the entire *Sphæra Vitrea* included in the aqueous Humour, converge to a Point that is diſtant three Semidiameters and a half from the oppoſite Superficies of the Sphere; or, what is the ſame, of the Point, or *Radiant*, which is diſtant three Semidiameters and a half from the *Sphæra Vitrea* included in the aqueous Humour, the Rays come out parallel behind the Sphere; and therefore the Image of that Point or ſmall radiant Body, will be at an infinite Diſtance from the Sphere, and by conſequence will not be painted upon the *Retina*, and no Senſation of that Point can be excited in the Organs of Viſion.

Wherefore, allowing the Obſervations in Optics, which prove that the ſame Refractions obtain in the Chryſtalline Humour, as in the Vitreous; it is manifeſt that no Image of the radiant Body, which is diſtant three Semidiameters and a half from the Chryſtalline Humour, can poſſibly be imprinted upon the *Retina*. But, as is evident, the *Cornea* of no Eye is diſtant from the Chryſtalline three Semidiameters and a half of the Chryſtalline. Therefore no Viſion follows from the Poſition of any Body in the *Cornea*, much leſs in the aqueous Humour; or the Corpuſcles that lie, or ſwim there, are imperceptible by the Eye.

From this Demonſtration it follows, that in a Suffuſion of the Eye no ſuch Images of Bodies are perceptible, as the Writers of Phyſic aſcribe to a Suffuſion, who by a very groſs Miſtake have attributed Symptoms entirely foreign to the Diſeaſes of the Eye. But if thoſe Images happen with an Obſcurity of Sight at the ſame time, then an *Amauroſis*, or what is commonly called a *Gutta Serena*, will be the Attendant of a Suffuſion.

2. Becauſe, if theſe Flies, Spiders, and ſuch ſort of Bodies ſeem continually skiming before the Sight, when there appears no Sign of an external Inflammation of the Eye, an *Amauroſis* ariſes, the Reaſon of which, and the Method of its being generated, I have more fully declared.

3. If theſe Images are accompanied with an external Inflammation, there is alſo an internal Inflammation, and that too ſituated in the *Retina* it ſelf. And as for this, I have long ſince made that Obſervation; for being convinced by Reaſons in Optics, that thoſe Images aroſe from a Defect of the Parts of the *Retina*, being too much covered by the extraordinary *Tenſion* and Oppreſſion of the Blood-Veſſels, I eaſily found that they who ſuffer'd by an Inflammation reaching to the *Retina*, muſt be affected by the ſame Symptoms.

4. And it is true in general, that theſe Films and Images in an *Amauroſis* ariſe from the Defect of the *Retina*, which is made unfit for the Reception of the Image, by the too great Diſtention of ſome Part of it, and the

too great compreſſing and covering of other Parts. And becauſe this Symptom of Oppreſſion may happen in the Veſſels of the *Retina* in any State or Condition, the *Retina* will be ſubject to the breeding all ſorts of *Tumours* that may at any time affect any other Part. Now in my Opinion it is evident to any rational Perſon, that he who underſtands theſe things cures by Art, and not by Chance. Thus then I have demonſtrated in a few Words the Theory of the Diſeaſes of the Eye, and at the ſame time have given an Inſtance of the Uſefulneſs of Mathematics in Phyſic; for the Method of Cure is eaſily to be drawn from this Theory, nor is it leſs plain how much they, who make uſe of *Collyriums* in theſe Caſes, baffle and impoſe both upon themſelves and their Patients.

* * *

A
DISSERTATION
UPON THE
Circulation of the Blood
Through the Minuteſt Veſſels of the BODY.

DR. Harvey has inform'd us, in a Syſtem entirely new, and providentially diſcovered, that the Blood runs from the Heart through the Arteries, and returns to the Heart through the Veins: and contenting himſelf with recommending this ſingle and general Hypotheſis to the *Belief of Phyſicians*, has left all the other Particulars in the dark, and unexplained. But when this was found not to anſwer ſufficiently Medicinal Uſes, the Learned began to diſpute, whether the Blood was conveyed from the Arteries into ſome Parts of the Body, where the Arteries and Veins are diſperſed with their Mouths unclosed, and open; or whether the minuteſt Arteries did not convey the more groſs Blood for the Nutriment of the Parts, but only the thinner part which was not to return to the Heart, and all the reſt of the Blood paſſed thro' the largeſt Arteries into the Veins, which are connected to them by *Anaſtomoſis*. It is plain to any Obſerver, that either of theſe *Hypotheſes* contradict the Circulation of the Blood. For the firſt empties a large Quantity of the thicker Blood (that is, ſuch as is contained in the greater Veſſels) into the Parts of the Body, or rather the Interſtices of the Parts. The ſecond empties the thinner part of the Blood (that is, what is contained in the leſſer Arteries) which is appropriated to the Nutriment of the Parts; that is, it ſuppoſes that a great part of the Blood does not circulate, but, as they expreſs themſelves, is detained and ſtagnated in the *Viſcera*, and the Pores of the Parts. But ſince all the Blood is forced by the Impulſe of the Heart, and the Arteries into a Circular Motion, in ſo much that while they act with their proper Vigour, the Blood cannot be at reſt, it is evident that it is impoſſible it ſhould ſtagnate in the minuteſt Veſſels, which muſt neceſſarily burſt by the continual Acceſſion of the Blood, or muſt be ſwelled to an extraordinary Degree by that Blood which is not to be conveyed thro' the Veins; which Accident never happens to any Animal in a State of Health: and it is as plain that it is not detained in the Pores, upon account of the continual Encreaſe which for the ſame Reaſon muſt neceſſarily follow. For the more Blood that was diſperſed in the Pores, the greater would be the Difficulty of its Returns from the Stoppage of the Veins by the circumambient Fluid, as ſhall be proved in the following Diſcourſe.

2. As the Phyſicians of all Men ſeem covetous of new Diſcoveries, ſo they are commonly taken with the Novelty of Terms: Thus there aroſe a Set of Men, who obſerving that there was a ſort of Glandulous Fleſh bundled up in the *Viſcera*, and which was provided with all ſorts of Veſſels, they made no Scruple of affirming that there are Glands in all Parts of the Body, which receive the Blood from the Arteries, and tranſmit it unaltered into the Mouths of the Veins, which open even within the Glandulous Subſtance, while they ſend another Part of it which is fit for Separation thro' its proper ſecreting Veſſel. But this Hypotheſis has brought nothing new into Phyſic, but only the Uſe of a Term. For this is all that it amounts to, the calling a Gland that *Medium*, which the Antients call'd ſometimes

times the Parts, and Subſtance of the Body, ſometimes the *Anaſtomoſis*, and which they would have to bear properly neither the Name of a Vein, or Artery. This Notion, as was unavoidable, is preſſed too with the ſame Inconveniencies; for as it has yet only appropriated the Arteries and Veins to open into the Cavity of the Gland, the Vein can only receive again a part of the Blood, the reſt will partly be excerned, and partly ſtagnated, to maintain the Subſtance and Nutrition of the Parts, which is entirely contradictory to the Circulation of the Blood, and is proved falſe after the ſame way of Reaſoning as we made uſe of in the preceding Paragraph.

3. But ſince it is evident, that the Notions of Men ought to be ſuch as are applicable to the Uſes of Life, and not the Vanity of Diſpute, therefore we may chiefly collect the Opinions of Phyſicians about the Circulation from the Books they have writ upon the Art of *Cure*. In thoſe moſt of them diſcover their Belief of the frequent Extravaſation of the Blood from the Mouths of the Hæmorrhoidal, Meſeraic, and other Veins; which Opinion they could never embrace, who had any Knowledge of the continual Motion of the Blood from the remoteſt Veins toward the Heart. But all Phyſicians, who have preſcribed any Method of Practice agreeable, as they would have it

thought, to the Circulation, unanimouſly agree in affirming that the Blood either ſtagnates in the Parts, or in the Glands; and becauſe the Blood, whether of the thicker, or thinner Texture, when detained in the Interſtices of the Parts, might ſuffer and induce all the ſame Symptoms, as were obſerved in the Blood by the Antients, who knew nothing of the Circulation; therefore the ſame Method of Cure which the Antients made uſe of, is almoſt every where follow'd by the Moderns, altho' generally contradictory to Experience, and the Laws of the Circulation. For this reaſon we are not to wonder why no greater Alteration is made in the Practice of Phyſic, ſince moſt Diſeaſes ariſe from ſome Diſorder of the Circulation in the leſſer Veſſels, which many of the Moderns plainly demonſtrate they underſtand no better than *Hippocrates* and *Galen*.

4. But altho' many Fluids are ſeparated from the Blood, which are never reſtored to it again, and ſo cannot be ſaid to circulate; yet there is a Neceſſity for ſome Motion of theirs dependant upon the Circulation of the Blood, ſo that if their Motion ceaſes, this too muſt either ſink into an immediate or a gradual Stagnation. Wherefore all Fluids that are ſecreted from the Blood, preſerve ſome conſtant Motion towards the ſame Parts, tho' at ſometimes a very ſlow one, as being preſſed by the Blood, which too is flowing con-

times the Parts, and Subſtance of the Body, ſometimes the *Anaſtomoſis*, and which they would have to bear properly neither the Name of a Vein, or Artery. This Notion, as was unavoidable, is preſſed too with the ſame Inconveniencies; for as it has yet only appropriated the Arteries and Veins to open into the Cavity of the Gland, the Vein can only receive again a part of the Blood, the reſt will partly be excerned, and partly ſtagnated, to maintain the Subſtance and Nutrition of the Parts, which is entirely contradictory to the Circulation of the Blood, and is proved falſe after the ſame way of Reaſoning as we made uſe of in the preceding Paragraph.

3. But ſince it is evident, that the Notions of Men ought to be ſuch as are applicable to the Uſes of Life, and not the Vanity of Diſpute, therefore we may chiefly collect the Opinions of Phyſicians about the Circulation from the Books they have writ upon the Art of *Cure*. In thoſe moſt of them diſcover their Belief of the frequent Extravaſation of the Blood from the Mouths of the Hæmorrhoidal, Meſeraic, and other Veins; which Opinion they could never embrace, who had any Knowledge of the continual Motion of the Blood from the remoteſt Veins toward the Heart. But all Phyſicians, who have preſcribed any Method of Practice agreeable, as they would have it

thought, to the Circulation, unanimouſly agree in affirming that the Blood either ſtagnates in the Parts, or in the Glands; and becauſe the Blood, whether of the thicker, or thinner Texture, when detained in the Interſtices of the Parts, might ſuffer and induce all the ſame Symptoms, as were obſerved in the Blood by the Antients, who knew nothing of the Circulation; therefore the ſame Method of Cure which the Antients made uſe of, is almoſt every where follow'd by the Moderns, altho' generally contradictory to Experience, and the Laws of the Circulation. For this reaſon we are not to wonder why no greater Alteration is made in the Practice of Phyſic, ſince moſt Diſeaſes ariſe from ſome Diſorder of the Circulation in the leſſer Veſſels, which many of the Moderns plainly demonſtrate they underſtand no better than *Hippocrates* and *Galen.*

4. But altho' many Fluids are ſeparated from the Blood, which are never reſtored to it again, and ſo cannot be ſaid to circulate; yet there is a Neceſſity for ſome Motion of theirs dependant upon the Circulation of the Blood, ſo that if their Motion ceaſes, this too muſt either ſink into an immediate or a gradual Stagnation. Wherefore all Fluids that are ſecreted from the Blood, preſerve ſome conſtant Motion towards the ſame Parts, tho' at ſometimes a very ſlow one, as being preſſed by the Blood, which too is flowing con-

tinually towards the ſame Parts. From whence it follows that thoſe, who attribute no Motion at all to the Fluids ſecreted by the Blood, or an arbitrary Motion to any Parts, either do not admit of the Circulation of the Blood, or do not underſtand it. Nor will it appear ſtrange that ſuch Phyſicians agree with the Practice of the Antients, and tho' they boaſt of the Circulation, yet that our Art owes very little to their Improvements: For the Circulation of the Blood is not more neceſſary for the Preſervation of Life, than its perpetual Supplies of the Secretion of abundance of Fluids, and its Diſpoſal of them into different Parts; and the Cauſes of moſt Diſeaſes are to be look'd for in the Diſorder of this Secretion, either as it is encreaſed or diminiſhed; in ſo much, that he who keeps to the Opinion of the Antients in the Buſineſs of Secretion, ought to practice after the ſame Method, as being ignorant of the Effects of the Circulation. Infinite is the Number of thoſe who diſſent from Dr. *Harvey*'s Demonſtration, among whom Dr. *Willis* is his moſt eminent Oppoſer. It ſeems to have been the Deſign of this Perſon to have endeavoured to overturn the Foundations of the Art of Phyſic, by the Reputation of his Learning, and his exceſſive Praiſes of Philoſophy; for his Books are full of nothing but old Notions diſguiſed under new Forms; and all his boaſted Philoſophy depends upon the uncertain wandering of the Blood to all Parts of the Body, and particularly upon the voluntary Motion and Refluence of his Nervous Liquor thro' all Manner of Paſſages. Let any one look upon the Books he has publiſhed, his *Pathologia Cerebri*, his Treatiſes *de Morbis Convulſivis*, and his *Pharmaceutica Rationalis*, where the Animal Spirits which are to produce the *Vertigo*, *Epilepſy*, *Convulſive Motions*, are ordered to move thro' the Pores, and any Interſtices of the Parts, backwards and forwards, and in a Circle, (and by his good will he would have drove them into many other Curve Lines, had he known their Names) ſince he had either forgot or deſpiſed the Knowledge of the Structure of the Brain, the Nerves, and the Laws of Circulation. But in other Diſtempers he makes Animal Spirits of a heavy Nature, and diſpoſed to ſleep; ſometimes he attributes Perception to them, at others a Quality like the Waters of *Styx*, and all entirely foreign to Fluids circulating in an Animal Body.

5. But Phyſicians of greater Sagacity ſeem to have avoided theſe Miſtakes, and theſe will have all the Blood ſtrained thro' the Glands, and part of it to return into the Veins, and the reſt to be diſpoſed of without the Glands into the ſecreting Veſſel. And ſo, as if they had agreed the Matter before-hand, that ſome at leaſt might fall into the Right, they took different Paths in their

Enquiries: They who cry up Chymical Medicines, attribute a certain native Liquor to every Gland, which they diſtinguiſh by the Name of a *Ferment*, that is, ſome fluid Particles, that ſeparating from the Blood as ſoon as it is made, paſs off into Receptacles agreeable to their Texture, to which they are carried by a natural Tendency, that is, a Tendency of Aſſimilation. Such, as they order the Matter, is the Quality of this Ferment, that the Blood, or the Part of the Blood which is ſo ſeparated, may be changed immediately into a Fluid of a different Quality, ſuch a one as is obſerved to proceed from that Gland, or a ſimilar Bundle of Glands. Thus for inſtance, they affirm, that Part of the Blood being carried to the Glands of the Liver, is, by the Force of the Ferment of the Liver, which Ferment is innate and congenial to the Glands of the Liver, immediately altered into mere Bile. The Maintainers of this Opinion are forced to ſay, the fermenting Liquors ſtagnate in any Part, and ſo cannot allow any Circulation of their *Ferments*; tho' to affirm that Fluids can come to a Conſiſtence, and in a State of Stagnation can mix with the circulating Fluids, without circulating themſelves, is contrary to the Circulation of the Blood, the Preſervation of Life, and the Nature of Things.

6. Yet I cannot help wondering, that there ſhould have been any who could have

believed that the Buſineſs of Secretion could be performed merely by the Aſſiſtance of Ferments: For tho' that Opinion (which grants that all Fluids contained in an Animal Body, are either impelled in a Circle, or in ſome direct Line of Motion, and that no Fluid can naturally be in a State of Reſt, or Stagnation) were not contrary to the Circulation of the Blood; yet other things beſides Ferments are made uſe of for the Office of Secretion, that is, for the Preſervation of the Circulation of the Blood; other Things, I ſay, which however when admitted plainly demonſtrate the Impoſſibility of Ferments, as ſhall be ſhewn hereafter. But they who have embraced this Hypotheſis, tho' in Words they acknowledge the Circulation of the Blood, yet in effect they have deſtroyed it. For how do their Opinions, who ſay that the Blood is detained in all the Glands till it is changed by the congenial Ferment, differ from the Antients, who taught that the Blood aſſumed different Qualities in different Places, and was affected by the natural Warmth, or particular Temperature of the Parts? or what more ſucceſsful Method of Cure could one proceed upon than the other? Whatever are the Grounds upon which they prefer themſelves to the Antients, they are all to a Man either ignorant of the Circulation it ſelf, or the Effects and moſt noble Uſes of it.

And indeed, ſince theſe Ferments have nothing to do with the ſolid Parts of the Veſſels, but the Fluids ſecreted from the Blood, the Secretion muſt neceſſarily be at one time performed without their previous Aſſiſtance, and therefore may be always ſo, without their Aſſiſtance.

The ſame Method of Reaſoning confutes thoſe, who aſſert that the Bile is ſecreted in the Kernels of the Liver, becauſe it unites itſelf with the Bile naturally implanted in thoſe Kernels, but will not mix with the Urine contained in the Glands of the Kidnies, depending upon the Experiment of a Paper, which tinctured with Oil will not let Water paſs thro' it, and which if it be firſt wetted with Water, the Oil will not paſs. Becauſe it is evident from what has been before ſhown, that this native Bile is to be accounted a native Ferment, and by conſequence ought to be entirely removed by the Force of the Circulation, and waſh'd away by ſucceeding Fluids of any ſort whatſoever. Beſides, it may be united to every Fluid contained in the Blood, as being before joined to all the Fluids of which the Blood is compounded, and ſo cannot poſſibly refuſe a Union with any of them: For I do not intend to diſpute here concerning the Attractive Forces.

7. Thus they who were not ſatisfied with thoſe Chymical Ferments, but fell into a

Method of explaining this Difficulty more agreeable to the Mechanics, and the new Philoſophy, invent theſe Means for the Secretion of a Fluid from its Union with the Blood. For it being allowed on all hands, that the Animal Blood is compounded of a Mixture of many Fluids, and that every one of theſe Fluids (if Homogeneous) conſiſts of ſimilar Particles, and of a different Figure and Bulk from the Particles that compoſe any other Fluid ; or (if heterogeneous) of Globules that contain Particles of different Figures and Bulk, and different too from the Figure and Bulk of other Fluids ; they have ſuppoſed that there are within the Glands Bodies of a Sieve-like Form, to which the Arteries convey the Blood, which upon its Arrival there adapting it ſelf to the Holes of that Figure, which is peculiar to the Maſs of the Fluid, it conveys or forces ſome Part of the Blood into thoſe Holes, in order to be carried off to the Secreting Veſſels, while the other Fluids return again thro' the Veins: So that the Pores of the Glands muſt be of different Figures in different Parts of the Body, according to the Diverſity of the Figure of the Parts of every Fluid contained in the Blood. This whole Buſineſs is illuſtrated by the Inſtance of a Sieve, which gives a free Paſſage to one ſort of Grain, and yet ſtops another ſort, not larger, but of a different Figure ; and again by the Inſtance of a Strainer, that is pervious by ſome kind of Fluids, while others which ſeem of a finer Texture cannot paſs. And there have been ſome who have joined this laſt *Hypotheſis* with the former of innate Ferments; and their Way of Reaſoning ought indeed to be followed by all the Patrons of Ferments.

8. For whatſoever kind of Ferment we ſuppoſe in every particular Gland, which is capable of changing the Blood impelled thither into a new Form and different Body; yet upon that Change it ought to aſſume ſuch a Figure, as is agreeable to the Orifice of the ſecreting Veſſel proper to that Gland, and which ought to be ſo framed as to exclude all Bodies of a different Figure; otherwiſe any Body of a ſufficient Subtilty may paſs thro' it without any Aſſiſtance from the Ferments: to prevent which all this plauſible Tale of Ferments is brought upon the Stage, and all this Reaſoning upon the Diverſity of the Figures in the Pores received with great Applauſe. Upon this account the Authors of the firſt *Hypotheſis* of a definite Number of Ferments, are obliged to have recourſe to the ſecond of a definite Number of Pores: For they having ſuppoſed different Ferments in different Glands, which ſeem neceſſarily to require Sieve-like Subſtances of a Variety of Figures, or Receptacles more agreeable to one Ferment than another, there was no Reaſon for their diſallowing

allowing the ſecond *Hypotheſis*, but their not underſtanding it. But however contradictory they may ſeem, who embrace the firſt and deny the ſecond Opinion, yet ſtill the ſecond has brought no real Advantage to Phyſic. Becauſe the Aſſertors may frame at their own pleaſure any Figures in the Parts of Fluids, and Pores anſwerable to them; neither can they be refuted, ſince they are ſo ſmall, as not to be the Objects of Sight: And thus it was eaſy for the Slaves to a Sect to adapt Pores and Reaſonings to the Principles of the *Galeniſts*, however in themſelves unſound.

9. There are two Reaſons which ſeem to have inclined the Aſſertors of the ſecond Opinion to make the Variety of Secretions daily obſerved in a ſound Animal depend upon the Diverſity of the Figures. Firſt, becauſe they fancied from the Inſtance of the *Sieve*, that ſome Bodies might paſs thro', and others, tho' not of a larger Size, could not, if there were only a Diverſity of Figures allowed. In the ſecond place, if it were not as they ſuppoſed, they could give no Reaſon why *Sweat* and other (if there are any) thinner Fluids, ſhould not paſs thro' the Orifices appropriated to ſecrete and carry off the groſſer Fluids, which would endanger Life. The Grounds of this Fear, more inſignificant than the Fear of a *Vacuum*, ſhall be removed at the End of this Diſſertation. Now we muſt examine the Inſtance

of the *Sieve*, and let us ſuppoſe a *Sieve* perforated with Circular Holes. If in this Caſe you apply ſpherical Solids of no greater Diameter than the Diameter of the Holes, they will paſs, and run thro'. But if you apply to the Holes, Grains of Corn, or any other Body of greater and leſſer Diameters than the Holes, the greateſt of which is greater than the Diameter of the Hole, the leaſt is not, then they will not paſs and run thro', if the largeſt Diameter happens to come parallel to the Diameter of the Hole: which is only a ſingle Caſe in this Inſtance. Becauſe they may be ſo apply'd, that the leſſer Diameter ſhall fall parallel to the Diameter of the Hole, or if not parallel, it may be inclined at any Angle; and theſe Angles being infinite, produce an infinite Variety of Caſes. And thus, without any regard to the Figure, this boaſted Argument of the Sieve is eaſily confuted. Wherefore to place the whole Matter in the cleareſt Light; let *A* ſignify the Conditions of Admiſſion; *E*, the Conditions of Excluſion, *q* the Turns of Admiſſion, *p* the Turns of Excluſion, then the Quantity ſought for will be $\frac{Aq + Ep}{q + p}$, as is evident from the Demonſtration of the Great *Huygens*. And ſince, as is proved, the Quantity *p* is finite, but *q* is infinite, therefore *p* is loſt, and the Product will be $\frac{Aq}{q}$, and by conſequence the Caſe of Admiſſion will always happen.

10. Whoever attentively conſiders how great a Portion of our Blood is of a watry Subtilty, or rather of a watry Fluidity, not to ſay entirely watry, and which Water or any thing of an aqueous Fluidity and Gravity, can by degrees and by a gentle Heat eaſily rarify, and ſeparate into any, even the minuteſt Particles; or if he conſiders the Nature of a Fluid, he will ſoon allow, that the Blood which flows thro' our Veſſels by the Force impreſſed upon it by the Motion of the Heart, may be ſeparated into Particles much more minute than the Orifices which it meets with in its Courſe; and yet every one of theſe ſeparated Particles may be a Fluid, and perhaps a compound of other heterogeneous Fluids; for every Fluid ought to be accounted a Body conſiſting of an infinite Smallneſs of Parts, which however in different Fluids requires a different Force to cauſe a Separation of thoſe Parts: So that the minuteſt Solids of Fluids are not ſecreted in the Veſſels and Glands, but the Fluids themſelves, tho' ſometimes but in a ſmall Quantity. For it is not to be imagined, that the Force impreſſed by the Motion of the Heart and Arteries is ſo great, as to be able to ſeparate the minuteſt Parts of the ſmalleſt Fluid from an Union with the reſt; for if ſo, we ſhould meet with Volatile Salts inſtead of Blood,

diſperſed thro' all the greater Arteries. But it is evident that Fluids do not require any peculiar or regular Figure, ſince they can adapt themſelves to any Figure, and penetrate any Orifice, ſuppoſing the impelling Powers ſtrong enough to break the Coheſion of the Fluid at the Entrance of the Orifice. From whence it follows, that if Fluids are ſecreted from the Blood of the Animal in a State of Fluidity, that there is no occaſion for any peculiar Configuration of the receiving Orifice, but that any will ſerve, if it be but large enough; neither are the Figures of the minuteſt Parts of the ſecreting Fluid of any conſequence in the Performance of the Work of Secretion.

11. But ſuppoſe they are not *Fluids*, which are ſecreted in the Glands from the Blood in a State of Fluidity, but that they are minute Solids, which being reaſſembled and brought out of many ſmall ſecreting Veſſels into a larger, compoſe a Fluid Body; let us ſee what is requiſite to put theſe in Motion. Here they aſſume, that the Orifice will admit and give a Paſſage to only a Body of a given Figure and Magnitude, excluding all others whatſoever, which is evidently falſe. For if the Body to be admitted is leſſer than the Orifice, and can be ſo placed within it, that all its Sections paſſing thro' Planes parallel to the Orifice, are leſſer than the Orifice given; then not only that Body, but an

infinite Number of others of any Figure may enter and paſs that Orifice. And tho' we ſuppoſe the greateſt Section of the Body ſimilar and equal to the Figure of the Orifice given; yet becauſe a great many different Bodies when cut bear the ſame Figure, therefore many different Bodies may paſs thro' the ſame Orifice, or many different Secretions may be made thro' the ſame ſecreting Veſſel. And thus this Hypotheſis about the Neceſſity and Convenience of the Figure of the Pores, falls to the Ground. Thus for inſtance, thro' the ſame Circular Orifice there paſſes not only a Sphere, all whoſe Sections are ſimilar and equal to the Circle of the Orifice, but a *Cone* and a *Cylinder* upon an equal Baſis; and thro' the ſame Triangular Orifice there paſſes a *Pyramid*, a *Priſm*, and a *Cone*, whoſe greateſt Sections paſſing thro' a Plane parallel to the Orifice, are equal Triangles, and ſimilar to the Triangle that makes the given Orifice.

12. Beſide, tho' there were no Obſtruction to the Admiſſion of a Body into an Orifice of a given Figure and Magnitude, from the Magnitude and Similitude of that Body, yet the Situation alone may be an Obſtruction. For ſuppoſe a *Cone* is to enter a given Triangular Orifice, altho' the Triangle meaſured by the Axis of the aſſumed *Cone* is not bigger than the given Orifice, but exactly ſimilar and equal to it, or even much leſs;

yet it is moreover requiſite for that Section of the *Cone* to be ſituated parallel to the Orifice, and the Poſition muſt be ſimilar while the Body approaches to it, or otherwiſe it cannot poſſibly enter. But it may happen infinite Ways, and all equally feaſible, both that the Section may approach in a different Poſition, and that Sections of different Figures may be applied to the Orifice, becauſe beſide a Triangle paſſing thro' a Plane parallel to the Plane of the Orifice, there is an infinite Number of Bodies, and great Diverſity of Figures, which may be all Sections of a given Cone, ſince a Triangle is only one Section of a *Cone*. And thus, there is but one ſingle Caſe wherein the aſſumed Cone can paſs thro' the Orifice given; but there are two ways an infinite Number of Caſes equally eaſy and credible, in none of which it can poſſibly paſs. After the ſame manner, if a *Cube*, ſuppoſe of Salt, be apply'd to a ſquare Orifice, every where ſimilar and equal, but yet not parallel in its Situation, ſo that Side and Side, and Angle and Angle, exactly agree, the *Cube* in this caſe will not be ſecreted thro' the given Orifice; but it may happen infinite Ways, that either the Angle may ſtrike againſt the Side (altho' the Surface is parallel to the Orifice) and in none of thoſe Caſes it can paſs; or that the Surface may not be parallel to the Orifice (altho' it agrees in all other things) and in none of thoſe can it paſs. The ſame may be affirmed of any Solid, except a Sphere; for all the Sections of that, with the Planes paſſing thro' its Center, and parallel to any Plane, are Figures equal and ſimilar, and of the ſame Situation, that is, equal Circles: So that a Sphere is the only Figure among Solids, which paſſes thro' a given Orifice at any Situation, as a Circle is the only one of plane Figures that admits a paſſing Body of any Figure, and at any Poſition, ſuppoſing the greateſt Diameter of that Body is not larger than the Diameter of the Circle.

13. From all which I draw this conſequence, that if there is a Neceſſity for an Agreement of the Pores and the Parts in the Work of Secretion, that no Secretion at all would ever be performed: but ſince we perceive that frequent and large Secretions are daily and neceſſarily made in every Animal, we muſt allow that there is no ſuch thing as that fancied Agreement in the Figures of the Pores, and the Particles ſecerned, as being what would entirely obſtruct the Buſineſs of Secretion. And the Force of this Reaſoning is founded upon this; if there be only one ſingle Cauſe to make any Secretion at all, and there are infinite Cauſes to obſtruct it; and if every one of theſe is as powerful as that ſingle one, we muſt conclude that that Secretion is never performed at all; and this Argument depends upon the

ſame Evidence and Neceſſity, as that Concluſion does of our allowing him abſolutely the Winner at the Game of Dice, who generally wins.

And to finiſh this Matter after the ſame manner as we uſed in the foregoing Paragraph.

Let A ſignify the Conditions of Admiſſion, E the Conditions of Excluſion; q the Turns of Admiſſion, p the Turns of Excluſion: then the Quantity anſwering Expectation will be $\frac{Aq + Ep}{q + p}$, as is plain from the Demonſtrations of the Great *Huygens*. And becauſe the Quantity q is finite, but p is infinite, as we proved in the 12*th* Paragraph; therefore q is loſt, and the Product will be $\frac{Ep}{p}$, that is, E; and ſo by conſequence the Caſe of Excluſion will always happen. *Q. E. D.*

14. But there is another irremovable Difficulty againſt this Secretion thro' Pores of a different Figure: For, to inſtance, a Cylinder may enter and fill the Orifice of a Parallelogram, if the Parallelogram generating the Cylinder be equal to the Orifice, ſimilar, and of the ſame Poſition. But ſuch a Cylinder will enter and fill a Circular Orifice, if the Baſis of the Cylinder is equal to the Orifice, and in the ſame Poſition. Wherefore if we allow, that Bodies ſwimming in

a

a Fluid do generally approach the Orifices obverting their greateſt Sections of the ſame Poſition, (which Conceſſion ruins our Opponents) then the ſame Bodies may be ſecreted thro' Orifices of a different Figure, and with the ſame Facility. Again, the ſame Cone, according to its different Poſition, will enter and fill a Pore or Orifice of a Triangular, Parabolical, Hyperbolical, Circular, Eliptical, and an infinite Diverſity of other Figures. Therefore allowing the ſame Poſition as before, the ſame Secretion will be made naturally, and with an equal Facility, thro' different Places and different Glands. Which is contrary to Obſervation, and is a direct Contradiction to the Inventers of this Diverſity of Pores.

15. It ſeems evident therefore, that the Orifices of our Veſſels, and the Pores of the Glands and Parts of our Bodies, do not differ in reſpect of Figure, but in the Largeneſs and Extent of Figure. Give me leave then to repeat here our former Obſervation, that a Circle is the largeſt and moſt capacious Figure of all Figures upon the ſame Diameter, and that it admits the Planes of all Figures in any Poſition whatſoever, provided they are not of a greater Diameter. Wherefore ſince it is infinitely more probable, that Bodies of ſo many different Figures being conveyed to an Orifice not Circular, will not fit it, and it is plain too, that thoſe Bodies

ſame Evidence and Neceſſity, as that Concluſion does of our allowing him abſolutely the Winner at the Game of Dice, who generally wins.

And to finiſh this Matter after the ſame manner as we uſed in the foregoing Paragraph.

Let *A* ſignify the Conditions of Admiſſion, *E* the Conditions of Excluſion; *q* the Turns of Admiſſion, *p* the Turns of Excluſion: then the Quantity anſwering Expectation will be $\frac{Aq + Ep}{q + p}$, as is plain from the Demonſtrations of the Great *Huygens*. And becauſe the Quantity *q* is finite, but *p* is infinite, as we proved in the 12*th* Paragraph; therefore *q* is loſt, and the Product will be $\frac{Ep}{p}$, that is, *E*; and ſo by conſequence the Caſe of Excluſion will always happen. *Q. E. D.*

14. But there is another irremovable Difficulty againſt this Secretion thro' Pores of a different Figure: For, to inſtance, a Cylinder may enter and fill the Orifice of a Parallelogram, if the Parallelogram generating the Cylinder be equal to the Orifice, ſimilar, and of the ſame Poſition. But ſuch a Cylinder will enter and fill a Circular Orifice, if the Baſis of the Cylinder is equal to the Orifice, and in the ſame Poſition. Wherefore if we allow, that Bodies ſwimming in

a

a Fluid do generally approach the Orifices obverting their greateſt Sections of the ſame Poſition, (which Conceſſion ruins our Opponents) then the ſame Bodies may be ſecreted thro' Orifices of a different Figure, and with the ſame Facility. Again, the ſame Cone, according to its different Poſition, will enter and fill a Pore or Orifice of a Triangular, Parabolical, Hyperbolical, Circular, Eliptical, and an infinite Diverſity of other Figures. Therefore allowing the ſame Poſition as before, the ſame Secretion will be made naturally, and with an equal Facility, thro' different Places and different Glands. Which is contrary to Obſervation, and is a direct Contradiction to the Inventers of this Diverſity of Pores.

15. It ſeems evident therefore, that the Orifices of our Veſſels, and the Pores of the Glands and Parts of our Bodies, do not differ in reſpect of Figure, but in the Largeneſs and Extent of Figure. Give me leave then to repeat here our former Obſervation, that a Circle is the largeſt and moſt capacious Figure of all Figures upon the ſame Diameter, and that it admits the Planes of all Figures in any Poſition whatſoever, provided they are not of a greater Diameter. Wherefore ſince it is infinitely more probable, that Bodies of ſo many different Figures being conveyed to an Orifice not Circular, will not fit it, and it is plain too, that thoſe Bodies

will by their Force and Motion change the Figure of the objected Orifice into ſome other, which will give Paſſage to them in any Poſition and Figure, that is, they will change it into a Circular. And this will happen much ſooner, and more certainly, if they are Fluids which are to enter the Orifice, and be ſecreted there: For tho' the Orifice were not a Circle, yet ſince the Parts near to the Center, that is, the Sides, are more preſſed and dilated by the entring Fluid, than thoſe which are more remote; that is, the Angles and Sides of the Orifice are more flexible and apt to give way; it follows then, that all the Parts of the Orifice ought neceſſarily to be dilated at equal Diſtances, and equally remote from the Center; and by conſequence the Orifice will change to a Circle.

But I am willing to give a farther Proof of this Matter to the favourable Reader. If a Fluid is forced down into the Cavity of a Tube with a great Force, that is, a Force far exceeding the Gravity of the Fluid, it is evident from Reaſon, and confirmed by frequent Experiment, that the perpendicular Force toward the Sides of the Tube is always joined to the Motion of the Tube towards its Length, which Force endeavours on all Sides, from the very Axis of Motion, to propel outwards, and that with an equal Force: becauſe there can be no Reaſon given why the Preſſure ſhould be greater towards ſome Parts of the Axis, and leſſer towards others, but that Reaſon, which may be drawn from the Gravity of the Parts of the Fluid, which the Queſtion ſuppoſes of no moment, on account of the other ſuperior Force which impels the Fluid. Now this Force is eluded, and the Tube for all that retains its proper Figure, if the Sides of it are ſtrong, and not much Elaſtic, unleſs the Preſſure be with ſo great a Force, as to break the Force of the Coheſion of the Parts, in which caſe the Sides of the Tube burſt, and fall to pieces. But if the Sides are flexible, elaſtic, and apt to give way, then it is impoſſible but that the Force muſt have its due Effect, and propel the Sides to equal Diſtances on every Part from a given Point of the *Axis*; and thoſe Diſtances muſt be of ſuch a Length, that the Tenſion of the propelled Sides, and the Elaſticity, will now become powerful enough to ſuſtain the Shock of that Force. In which caſe, whatever Figure the Tube had at firſt, it will afterwards be changed into a different one, all whoſe Sections perpendicular to its Axis will be Circles of a greater or leſſer Diameter, according to the greater or leſſer Force of the Fluid, or the greater or leſſer Flexility of the Tube in its different Parts. Now ſuch kind of Tubes, and of ſuch a Flexility, are all the Veſſels in an Animal Body, and thro' theſe the Engine of the Heart propels all the Fluids with ſuch a Force, as far exceeds the Gravity of the Fluids propelled.

16. There will appear then no diverſity between the Figures of the Pores and Veſſels in an Animal Body, ſince they are all circular, but only the diverſity in reſpect of their greater and leſſer Diameters, which is a Difference that muſt have been allowed, whether we had called in the Operation of Ferments, or the Structure of Pores of different Figures. And this Simplicity, and thoſe few *Poſtulata's* which diſtinguiſh our Hypotheſis, is a genuine Evidence of that Truth, which the Greateſt and Beſt Geometrician has been pleaſed to affix to it. For a good Geometrician never teaches to build a Problem in a perplexed Method, which may be done in a plain and ſimple one. And ſince my Diſcourſe has led me to mention Geometricians, I cannot forbear congratulating this Age, and our Science, upon its producing many and great Improvers of Geometry to ſo high a Pitch, but particularly Sir *Iſaac Newton*; ſince we may juſtly hope, that by the Aſſiſtance of the Principles demonſtrated by that Great Man, the Powers and Properties of Bodies ſerviceable to Medicinal Uſes and the Comfort of Mankind, may be diſcovered with greater Eaſe, and reduced to a greater Certainty. Nor do I diſown that the Art of Phyſic pleaſes me not ſo much on any other account, as its being capable of bearing

the Method of Geometry in the ſame manner, as all thoſe other Arts which determine the Powers of Bodies; ſo that I cannot help pitying thoſe who accuſe the Nature of Bodies as a mean ignoble Subject, ſince the Geometricians demonſtrate, in the moſt convincing Method, ſuch a beautiful and ſo infinite a Number of their Properties.

17. But to return from whence I digreſſed. Since all the Orifices of all our Veſſels are of the ſame Figure, that is, Circles, all the Pores of the Glands too muſt be Circular, (I call thoſe Glandulous Sieves or ſecreting Mouths of the Glands, Pores, in this place) *and by conſequence there are no peculiar Receptacles of Ferments, and no Ferments at all in an Animal Body.* And indeed, ſince we have proved the Orifices of all our Veſſels ſimilar, the Ferments can in this caſe contribute nothing to Secretion, but the Comminution of the Blood into Particles of a proper Smallneſs. But it is plain that this may be performed only by the Action of the Lungs, the Force of the Heart, and the Compreſſion of the minuteſt Arteries. For if theſe Ferments are not mixed with the Blood, they cannot be the Cauſe of any Separation of Particles in the Blood, that is, they cannot be the Cauſe of any Secretion; but if they are mixed with it, they will be carried by the Force of the *Harvean* Circulation thro' all the Veſſels of the Body; and

any Ferment will cauſe a Secretion in any place ſimilar to the Secretion of its original Place, unleſs you ſuppoſe that it is obſtructed by the Diverſity of Figures (as we adviſed theſe Patrons of Ferments to aſſert in our eighth Paragraph ;) which Opinion we have already refuted and diſcarded.

18. From what has been proved I draw this farther Conſequence, That there is no intermediate Space or Body between the Evaneſcence of an Artery and the Riſe of a Vein, which can either be called the Pores or Interſtices of the Parts, or reckoned as a Gland, that is, ſuch a Space between which the Mouths of the Artery or Vein ſtand diſtinctly uncloſed and open. For the Blood evacuated into that Space or Body would much more eaſily compreſs and force the Sides of the Membranes which compoſe the Mouths of the Vein to a Contact, than enter into that Mouth ; and then the Blood would not return thro' the Veins to the Heart: But it does return, and thro' them too, wherefore there is Neceſſity for their Mouths to be joined and connected to the Mouths of the Arteries ; for there is no ſuch thing as that diſtinct Gland of the Poriſts, that intermediate between a Vein and an Artery, furniſhed with Pores and Orifices, or abounding with Ferments of different Figures according to the Diverſity of the Parts ; but that Gland which is ſerviceable in Secretions,

tions, is Part of the Veſſel which forms that Vein and Artery, and the Veins are nothing but Arteries turned back toward the Heart with a contrary Direction. From whence it follows that no Parts of a Human Body, beſides the Veins and Arteries, require a Reparation, for Supply of which the Blood ſhould be diverted either thro' the open Mouths of the Veſſels, or Pores of the Coats, from its glorious Tract diſcovered by Dr. *Harvey*.

19. But altho' there are no ſuch Glands as the *Poriſts* fancy, yet for the better Regulation of our Diſpute, we ſhall call that Part of the Arterial Curvature, from whence the firſt Root of the Secreting Veſſel ariſes, a Gland. Wherefore we proceed to remove the ſecond Difficulty which we mention'd, which ſeems to have induced a great many to fall in with the Hypotheſis of the various Figure of the Pores. Becauſe there are ſecreting Veſſels of a different Amplitude opening into different Arteries, yet the Arteries and Veins are equally full of ſome Fluid; and becauſe the antecedent Blood in the Veins reſiſts that which is to follow thro' the Arteries, more than a Fluid already conveyed into the Secreting Veſſels does that which is to follow thither, that being reſiſted only by the Air, which will eaſily give way. (I ſpeak now particularly of Secretories that diſcharge their Fluids without the Animal;) therefore whatever Fluids can

meet with Secretories large enough, will ſeparate at the ſame-time from all the Arteries: So that, while the thinner Fluids paſs from one Artery, or the Section of an Artery, thro' the Secreting Veins, which at the ſame time deny Paſſage to the groſſer Fluids; theſe groſſer, or comparatively groſſer, will paſs thro' the larger Secreting Veins, either from another Artery, or a Section of the ſame. I do not here diſpute of the Fluids which are diſcharged thro' the Lymphatic Veſſels and the Nerves, it being ſufficient to obſerve upon them, that there is ſuch a Reſource of Fluids in the Blood, adapted to ſupply thoſe Veſſels, that they cannot all at one time be directed to any Part. But I return to the Secreting Veſſels, thoſe that are called ſuch in the common Acceptation, becauſe they carry the Fluid to be diſcharged without the Body. Now they are ſuppoſed to be generated either by the Conglomerate Glands, ſuch are the Kidnies and Liver, or from the Conglobate, ſuch are in my Opinion the Cuticular Glands. Theſe, I ſuppoſe, carry off the thinner, and thoſe the groſſer Fluids; and it is evident that the Orifices of the former are larger than thoſe of the latter, as the Number of the latter is greater than that of the former: For it is requiſite, that the Number and Bulk of the Veſſels of the larger Orifices, ſhould bear ſuch a Proportion to the Number and Bulk of the

Veſſels of the leſſer Orifices, as to make it impoſſible for all the thinner Fluids to paſs at once thro' the Paſſages admiſſive of the groſſer. But I would have it obſerved here, that the Secretions which are the Subject of this Diſcourſe, do not include the Excrements, which are diſcharged thro' the *Alvus*, and never enter the *Venæ Lacteæ*, ſince we diſpute here only of thoſe Secretions which are performed within the Animal it ſelf, and ariſe from the Supplies of the circulating Blood; for as for thoſe in the Stomach and Inteſtines, they happen without the Animal. Let us in the laſt place remember, that pure Secretions very rarely happen, but that moſt commonly one is mixed and tinged a little with another, and that the groſſer Part is diluted by the thinner, which is ſecreted at the ſame time.

20. And now for the Illuſtration of this Point, it will be of uſe to obſerve, that

I. *If the Veſſels are equal in Number in two Places, and each of an equal Diſtance from the Heart, the Quantity ſecreted in the firſt place ought to be to the Quantity ſecreted in the ſecond, as the Sum of the Orifices in the firſt is to the Sum of the Orifices in the ſecond, ſince there is nothing beſide which can cauſe any Difference.*

II. *And then, if the Orifices are equal, the Quantity ſecreted in the firſt place ought to be to* *to the Quantity ſecreted in the ſecond, as the Number of the ſecreting Veſſels in the firſt is to the Number of ſecreting Veſſels in the ſecond, ſince there is nothing beſide, which can cauſe any Differenee.*

And from hence (for we have omitted the Celerity, as ſuppoſing that equal from the Circulation of the Blood) any one by the Aſſiſtance of the common Elements of Arithmetic may compare the Quantities of any Secretions with others of a different Evacuation, that is, thoſe which paſs thro' the greater or leſſer Veſſels. It appears plainly, from what has been demonſtrated, that, in whatſoever Animal the Orifices of the Veſſels appropriated for the Secretion of the groſſer Fluids, all taken together, more exceed the Orifices of the Veſſels ſecreting the thinner, than the Number of theſe exceed the Number of thoſe; more will be diſcharged from that Animal by *Senſible*, than by *Inſenſible* Evacuation. But ſince this never happens to a Human Body in a State of Health, it is neceſſary that the Proportion of the Orifices in that Body ſhould not exceed the inverted Proportion of the Number. So that we may ſafely infer, if the Veins ſecreting the thinner, are in Number to thoſe ſecreting the groſſer Fluids, as 4 to 1; and the middle Quantity of the Orifices of the Veſſels appropriated to the groſſer, is to thoſe of the thinner, as 9 to 4; that the Quantity of the thinner Fluid will be double that of the groſſer ſecreted in the ſame Space of Time: Which is agreeable to *Sanctorius*'s Experiments. If now, without altering the Proportion of the Numbers, we ſuppoſe the middle Diameter of the Secretories of the groſſer, to be to the middle Diameter of the Secretories of the thinner, as 100 to 99; the Proportion of the groſſer Secretion to the thinner will be the ſame, as 1 to 4. And this ſeems to be the Caſe of thoſe who waſte with too much Sweat, which ariſes from the Encreaſe of the Amplitude of the Veſſels appropriated to the Secretion of the thinner Fluids. But if, the Proportion of the Numbers being ſtill the ſame, it happens from any Cauſe that the Diameter of the Secretories of the groſſer, is to the Diameter of the Secretories of the thinner, as 5 to 2; then the Quantity of the groſſer Secretion will be about a third Part larger than the thinner; which is the Caſe of thoſe who are afflicted with a *Diarrhœa*, a *Diabetes*, or a Salivation, from the Encreaſe of the Amplitude of the Veſſels ariſing from the Conglomerate Glands. From whence we ſhall have no occaſion to wonder, why upon the Encreaſe of one Evacuation, another is ſometimes diminiſhed.

21. But I had rather enquire what Advantages the Students in Phyſic may obtain from

this Diſſertation. Firſt then, they will have no occaſion to apply themſelves to that nauſeous Doctrine of Ferments appropriated to every Part; which Hypotheſis made the Art of Phyſic in its own Nature obſcure, an unattainable Intricacy. Again, we ſhall have no farther Neceſſity for inventing of Figures, and entertaining our Reaſon with idle Fictions; and we ſhall be enabled to judge more eaſily what ſort of Medicines ought to be applied to the Diſorders in Secretion, as ſoon as we underſtand that the ſucceſsful Powers of Medicines depend upon fewer Properties than they have been hitherto imagined to depend; eſpecially ſince in the next place we have here ſhown, that thoſe Diſeaſes, for which theſe Remedies are ſought after, ariſe from the feweſt and moſt ſimple Cauſes. Nor will it be nothing to a generous Spirit, willing to improve an Art that requires ſo much Time, to be condemned no more to ſo many eternal Compilers, and impertinent Triflers, who by not underſtanding the Circulation, have too long and too unhappily prevented the nobleſt of all Inventions from anſwering the Hopes and Wiſhes of Mankind. I will conclude this Diſſertation with this Suggeſtion, that from theſe Principles any one may eaſily attain to a Method of explaining the Symptoms and Uſes of many of the *Viſcera*, which are not as yet fully underſtood, and ſolve many Problems, which eſcaped the Induſtry and Curioſity of ſo many of their Predeceſſors.

COROLLARY.

From the Principles here laid down, it follows, that the inſpired Air is not mixed with the Blood in the Lungs, for the Service of Reſpiration.

* * *

A DISSERTATION

Of the Cauſes of the different Gravity that the Blood flows with thro' the Lungs of living Creatures, and Embrio's.

THE Solution of a Problem ought never to be attempted by many *Poſtulata*, and the Aſſiſtance of dubious Theorems, which may be eaſily proved by a few *Poſtulata*, and the Aſſiſtance of a ſelf-evident Theorem: Neither ought any thing to be ſuppoſed to be tranſacted by the Paſſage of Bodies unknown in Nature, and unallowed in Diſpute, thro' Pores unknown and unallowed: In the laſt place, no Power or Faculty of Bodies, the Exiſtence of which may be reaſonably diſputed, and many do diſpute, ought to be made uſe of, when there is a Power nearer, and of a Force equal to the Work required, or a Quality ſo conſpicuous, that no Body can doubt of, but is univerſally confeſſed, and allowed. Upon this account I am diſpleaſed with their Reaſoning, who, in order to explain the extraordinary Powers of *Mercury* beyond the Force of moſt other Bodies, when it is conveyed into the Veſſels of Animals to expel ſome Fluids not eaſily put in Motion, do not ſcruple to recur to a certain Power of Salt extracted from the Aſhes of Plants, a ſort of Rival to Nature, which they imagine to be in *Mercury*, and endowed with Force enough to work out the Salts and Acid Fluids, and carry them off with its ſelf thro' the Veſſels of the Body. For theſe Perſons take for granted two Poſitions very uncertain, if not evidently falſe, that all Diſeaſes, for the Cure of which *Mercury* is made uſe of, ariſe from a Redundance of Acids, and that *Mercury* is of the ſame Nature as *Lixivial Salts*. They too philoſophiſe much after the ſame manner, who in order to ſhew why the Wood of *Guiacum* is more powerful than other Woods (which Phyſicians uſe in Diſeaſes of the ſame kind) attribute to *Guiacum* the Nature of Salts, which they call, from their Levity, *Volatile Salts*; becauſe, beſides other Uncertainties, they take it for granted that the Action of the Stomach and *Viſcera* in Animals changes all they receive into the ſame Forms, as we expreſs from them by the Aſſiſtance of a ſtrong Chymical Fire; which, as we ſhall prove in another Diſſertation, is too large and unreaſonable a *Poſtulatum*. Now I, to prevent being forced to uſe either too large or too many *Poſtulatas*, and uncertain or perhaps falſe Theorems, only obſerve that the Gravity of *Mercury* exceeds that of other Minerals, which Phyſicians apply for the ſame Purpoſes; and by conſequence it having a proportionable Celerity (which is every where equal to the Celerity of the Blood,) is ſuſceptible of a greater Quantity of Motion, and exerts a greater Force; and there is no other Quality wanting here, which any one will allow to be in Mercury, and other Medicines applicable to the ſame Uſes. But I believe it very uncertain, whether Mercury be of the ſame nature as common Salt of Tartar, unleſs it can be firſt proved that Gold is of Nature allied to Acids, and many other Matters yet obſcure, be firſt explained: For as for *Guiacum*, that Acid Liquor which it affords in a Chymical Diſtillation, as it ſhows the Gravity of the Wood, ſo it betrays a Quality in the Opinion of ſome, oppoſite to Acids.

From whence it follows, that the common Mercury cleanſed from all lighter attendant Bodies, is *cæteris paribus*, a more efficacious Remedy, than when it is prepared and joined with Salts, and ſuch kind of Subſtances: And that the Force of Gold reduced into a Liquid, or any Form commiſcible with the Blood, is proportionable to its Weight, and that ſuch a Preparation of Gold would as far exceed all other Remedies in its Virtues, as it ſhould exceed them in its Weight.

2. Now they who undertook the difficult Task of explaining Reſpiration, ought to have taken notice of theſe Obſervations. For the Miſtake of Phyſicians lay ſolely in this Point, ſince they run to Philoſophiſing, upon the aſſuming of a Number of leſs known Qualities for the Explication of that which is performed by one ſingle generally known Faculty of a Body generally known. But to make this plain, it is neceſſary to enumerate ſome of the moſt ſimple Symptoms, and common Phænomenas of Reſpiration.

1. *It is a Phænomenon, that the Lungs of an Animal,* v. g. *of a live Dog, upon opening the* Thorax, *immediately grow flaccid, and fall together, and the Circulation of the Blood, and the Motion of the Heart ſoon ceaſe; which does not happen in other Creatures, all whoſe Blood does not paſs thro' the Lungs.*

2. *That a Dog, ſtopping his Mouth and Noſe according to Art, ſo that the inſpired Air*

Air cannot be emitted, immediately dies; which Caſe is not the ſame in other Animals.

3. *That a Dog ſhut into a Place full of Air, but cloſed according to Art, immediately dies, which does not happen to other Animals in the ſame Caſe.*

4. *That the* **Human** Fœtus *lives in the Womb without the Aſſiſtance of the Air conveyed thro' the* Trachea *into the Lungs, and reſpired.*

5. *That a* **Human** Fœtus, *when born, and wrapped up in its Membranes entire, lives in the Water without Danger of Suffocation, and yet when taken out of the Secundines, after it has once received the inſpired Air, it cannot ſurvive without the Continuance of that Inſpiration.*

6. *That the Blood being drawn out by Transfuſion from a Dog of a free Reſpiration, or a Puppy at its firſt Reſpiration, into another whoſe Mouth and Noſtrils are cloſed (and, if that ſeem neceſſary, as great a Quantity being taken from the one, as it has received from the other) the Dog, or Puppy whoſe Mouth and Noſtrils are cloſed, immediately dies. The ſame happens upon the Immiſſion of Milk.*

7. *That a Dog encloſed, in the Pump of* Guerikius's *Invention, or commonly called* Boyle's, *the Arteries being extracted, immediately dies, but a Puppy lives much longer, and ſo do other Animals, who have a leſſer Quantity of Blood paſſing thro' their Lungs.*

8. *That the Air, in which the encloſed Dog dies, is a little before the Death of the Animal of the ſame Gravity and Elaſticity as it was when the Animal was firſt encloſed.*

3. Theſe are the principal Phænomenas of that Reſpiration which reſpects Mankind; and becauſe all of them diſcover a ſort of neceſſary Relation between the Circulation of the Blood (in which the Life of Man conſiſts) and the Power, and Nature of the Air, therefore we ought firſt to determine what we mean by the word *Air*. It is evident in my Opinion, that we ought in this place to take for the *Air*, a fluid Body, capable of forcing it ſelf thro' the *Trachea*, and the ſmalleſt Branches of the *Trachea*, into the extremeſt Parts of the Lungs, but not capable of penetrating the Pores of the Coats that cover the Lungs, no more than it can thoſe of Glaſs. And becauſe the ſame Fluid which we inſpire upon the opening of our Mouths, is not known to us by any Quality, ſo much as its Gravity, and Elaſticity, it is ſufficient to call the Air here an elaſtic Fluid, whoſe Denſity is proportionable to its Compreſſion, ſince we know of no other Fluid beſide the Air, which can be compreſſed into Spaces reciprocally proportional to its compreſſing Powers.

4. Now we muſt give the State of the Queſtion. But neither ought it, nor can it

be ſtated in other Words than Dr. *Harvey*'s, who in his Treatiſe of *the Birth*, in his Book of the *Generation of Animals*, propoſes to the Enquiry of the Learned;

“ How an Embryo can live in the Womb of the Mother, without the Inſpiration of the Air thro' the *Trachea*, as I ſhall ſoon ſhow it does; and yet the ſame, when excluded, immediately reſpires, and cannot ſurvive ſo much as an Hour without Reſpiration: But if continuing in the Womb beyond nine Months, it can live and be well without the Benefit of Reſpiration? Or how it comes to paſs, that a *Fœtus* born, and covered in its Membranes entire, and ſtill encloſed in its own Water, can live without Danger of Suffocation for ſome Hours; yet the ſame *Fœtus*, when out of the Secundines, if it once draws in the Air thro' the Lungs, cannot ſurvive without it ſo much as one Minute, but immediately dies. In the ſame manner, when a *Fœtus*, in the *Cæſarean* Operation is taken out ſome Hours after the Death of the Mother, it is found alive, and ſurvives within the Cover of the Secundines, not requiring the Benefit of the Air. But as ſoon as it has once enjoyed it, if it be placed again in the ſame Secundines, it is ſuffocated for the want of the Air. So far he. And from hence I ſhall begin to explain what others before me have thought more probable, and adapted to the Solution of this Queſtion, and by what Reaſons they have confirmed their Opinions, and how often they have deviated from the Rule I laid down at the beginning.

5. Whoever conſiders the Phænomena which we mentioned, will readily own the Errors of *Alphonſus Borellius*, (but the Error of how extraordinary a Perſon!) in the 113*th* Propoſition, and the following Part of his ſecond Book, of the *Motion of Animals*, when he declares that he has proved that the Particles of the Air are mixed with the Blood by the Force of Reſpiration. For, ſays he, becauſe there is a watry ſerous Juice always found in the Blood, and ſuch a watry *Serum* being put into Motion by the Preſſure of the inſpired Air, turns to a Froth, which Froth is therefore impregnated with aerial Particles; and the ſame Water is capable of an eaſy Penetration thro' the Pores of the Veins: It is impoſſible but that it muſt carry with it ſome entangled Particles of Air, and mix them with the Blood: But ſince the Particles of Air mixed with the Blood are elaſtic, and are never preſſed with the ſame Force for the ſpace of two Minutes together, therefore they will always free and reſtore themſelves from their Compreſſion, and by that Means propagate an Oſcillatory Motion (in which the Life of Animals, according to *Borellius*, conſiſts) which is uncertain, and

ſubject to change every Minute. But it is plain from our former Obſervations, that this Opinion is vain and groundleſs: For this gives no Solution of Dr. *Harvey*'s Problem. Any one may ſtill *quære* in Dr. *Harvey*'s place; how it is then poſſible to happen, that the *Fœtus* when born, and covered in its Membranes entire, ſurvives for ſome Hours without danger of Suffocation, and yet the ſame *Fœtus*, upon the Removal of the Secundines, if it once draws the Air into the Lungs, cannot ſubſiſt without it afterwards the ſpace of a Moment, but immediately dies.

For if it is neceſſary for the Support of Life, that ſome part of the Air ſhould be mixed with the Blood in its Courſe thro' the Lungs, the ſame Neceſſity requires that it ſhould be mixed with the Blood of the *Fœtus*, while it lies within the Secundines ſeparated from the Womb: But the *Fœtus* maintains Life within them without Reſpiration, and the Aſſiſtance of the groſs and common Air, and yet when that very Air, upon the Removal of the Secundines immediately after the Birth, ruſhes into the Lungs, it cannot afterwards ſubſiſt without it. Again, any one who conſiders our firſt Phænomenon, will plainly diſcover, either that no part of the Air enters the Veſſels of the Lungs, or that it is of no moment, and contributes nothing to the Action of Reſpiration. Becauſe, in Frogs, the Sea-Tortoiſe, and Animals of that kind, and in Human *Fœtus*, or any ſimilar to it, when involved in the Secundines entire after the Birth, far the greateſt Quantity of the Blood flows thro' the Heart, without approaching the Lungs, and requires no Aſſiſtance at all from the Air: And this is the Reaſon why thoſe Animals continue alive ſo long a time after opening the *Thorax*. But in Caſes where all the Blood is carried thro' the Lungs (as in a Man after free Reſpiration) thoſe Animals die immediately upon opening the *Thorax*, becauſe upon the ſudden Irruption of the Weight of the Air, not paſſing thro', but compreſſing the Veſſels of the Lungs, it is not the fine and more ſubtle Part, but the groſſer Air which is excluded from the Veſicles of the Lungs, that Part of the groſſer Air, I mean, whoſe Office it is to fill and diſtend the Pulmonary Veſſels.

Again, if the Mixtures of any part of the Air with the Blood in the Lungs is of Uſe or Advantage in Reſpiration, we may reaſonably enquire of *Borellius*, how comes it to paſs, that a *Puppy*, (whoſe firſt and private Paſſages for the Blood are not yet cloſed) ſhould live longer in the Air-Pump, the Air being extracted, than a Dog, tho' of a much greater Strength? For if the Air, or a Mixture of part of the Air with the Blood, is of any Uſe, there is an equal Danger of Death in both Caſes,

6. But *Borellius*'s Opinion is more evidently refuted, by the help of the ſecond and third Phænomenon, and again by the ſixth and eighth: For if an *Oſcillatory* Motion in the Blood produced by a Mixture of part of the Air, is neceſſary and ſufficient for the Preſervation of Life, the Animal whoſe Mouth and Noſtrils are cloſed, but whoſe Lungs are inflated with Air, muſt have that Motion, and ſo muſt the Animal encloſed in a place full of Air, but not open. For the elaſtic Air cannot be wanting in this Caſe; and, if we believe *Borellius*, neither Reſpiration nor Life can be wanting, as long as any part of elaſtic Air remains: but it is plain from the Phænomena, that the Air does remain, and that of the ſame Gravity as when the Animal was firſt encloſed. But if the ſixth Phænomenon is conſidered, it will appear, that this Oſcillatory Motion impreſſed upon the Blood by the Mixture of the Air, is neither neceſſary nor ſufficient for the Uſes of Life. Becauſe the Air will not be more eaſily conveyed to the *Fœtus* by the Aſſiſtance of the maternal Blood, than it will by the Aſſiſtance of the Transfuſion we mentioned from the reſpiring Dog to the Dog not reſpiring, which however will not live longer than if he had received no Blood mixed with Air: ſo very uncertain and fugitive is that Life which is expected from a Mixture of Air with the Blood.

7. There is no neceſſity for examining the Notion of *Wolfgangus Wedelius*, who lays down in the 127*th*, and the following Pages of his *Phyſiologia Reformata*, that the Life of Animals depends upon a ſort of Reciprocation of a certain innate and vital Air, with the external Air mixing and communicating with the internal Maſs of the Blood: By which Words it appears that he deſigned to adopt the Notion of *Borellius*, and ſubſtitute the Term *Reciprocation* in the Place of his *Oſcillatory* Motion; but he has encreaſed the number of uncertain Notions upon which *Borellius*'s Hypotheſis depends, by bringing in upon it a certain vital Air; and ſo applying two ſorts of Air for the Performance of that Buſineſs which *Borellius* managed by one known kind of Air. Let it ſuffice to remark, that this Reciprocation is proved uſeleſs and repugnant to the Nature of Things from the ſame Reaſons, as *Borellius*'s *Oſcillatory Motion*, and Mixture of the Air with the Blood in the Lungs, was before; and ſo we have overthrown the very Cauſe and Foundation both of the *Oſcillatory Motion*, and *Wedelius*'s Reciprocation.

Neither is there any more Neceſſity for entring into a prolix Diſcuſſion of *Bohnius*'s Opinion in the 78*th* Page of his *Anatomico Phyſiological Circle*, where he ſays that only a Part of the Air is conveyed into the Blood in Reſpiration, but that it is the moſt ſubtle Part, and yet not Elaſtic, tho' he allows it the very Cauſe of the Elaſticity of the Air, upon account of its perpetual Motion, which is peculiar to a Spherical Figure. For *Bohnius* readily allows the ſubtle Air to be of a ſpherical Figure, and to enjoy the perpetual Motion of a ſpherical Figure, by which our *Vitality*, as he loves to expreſs himſelf, proceeding from the Motion of the Blood aſcribable to that Part of the Air, is kept up and preſerved. This is *Borellius*'s Hypotheſis, and therefore no wonder it anſwers Dr. *Harvey*'s Problem, and agrees with the *Phænomena* no better than that does.

8. But we muſt now examine their Opinions, who think it evident from many Arguments, that ſome Part at leaſt of the Air is received into the Veſſels of the Lungs for the Uſe of Reſpiration; which however we have already ſhown, and ſhall farther ſhow, in the Proſecution of this Subject, to be falſe and groundleſs.

Let us then begin with that Argument, which is drawn from an Obſervation of Dr. *Lower*'s. He obſerved, that the Blood was ſent into the Pulmonary Artery of a black Colour, but that it came out of the Pulmonary Vein florid and ruddy: Again, upon the Cloſure of the *Trachea*, that the Blood flowed black from an Aperture of the Cervical Artery: In the laſt place, that in a dead Animal, if the Blood in the *Vena Cava* continuing ſtill in a State of Fluidity, were forced thro' the Heart, and the Lungs dilated at the ſame time by the Bellows, it would ſpout from the Lungs of as ruddy a Complexion, as it did when the Animal was living. But he has not proved, which he ought to have done, that this Change of Colour could proceed from no other Cauſe, but a Mixture of the Air: for notwithſtanding this Obſervation, it may proceed from the alternate Compreſſion of the Veſſels of the Lungs; and ſo the Solution of the Parts of the paſſing Fluid may be produced by the Irruption of the Elaſtic heavy Air, and not by its Mixture with the Blood. And Dr. *Lower*'s Obſervation equally proves that there was no ſuch Preſſure, as it does that there was no ſuch Mixture. And every one will readily allow, that as much Air was mixed with that Part of the Blood, which comes out upon the firſt Aperture of the Vein, and at laſt ſettles of a black Colour at the bottom of the Veſſel, while it is falling thro' the Air, as can be mixed with the Blood in that ſhort Paſſage thro' the Lungs: But on the other ſide, that the Agitation and Solution of the Parts of the Blood is much greater within the Veſſels of the Lungs, than in the Bottom of a Veſſel at reſt. Laſtly, to oppoſe one Obſervation to another, let the Patrons of this Opinion ſhew how it comes to paſs, that the Blood which we perceive of a red and florid Colour in the Time of Emiſſion, being ſoon after expoſed to the Air, often loſes that Redneſs? And whether or no this Obſervation does not prove the Redneſs of that Blood entirely owing to the Preſſure of the Lungs and the Heart? For it is not a Deficiency of the Air in this caſe, but of Motion, and the Solution of the Parts impreſſed by the Heart and Lungs. But more of this at the End of this Diſſertation. However, read upon this Subject the very Learned Dr. *Liſter*'s firſt *Anatomical Diſſertation* on *Shell-fiſh*, *p.* 101.

Let the ſecond Argument be that which is drawn from the *Miaſma's* and *Effluvia's* which kill ſuddenly by being drawn with the Air into the Lungs, and ſo are mixed with the Blood in the Lungs, which could not poſſibly be, unleſs their Vehicle, the Air, was carried into the Blood-Veſſels of the Lungs. But it ought to have been proved, that the Powers of theſe *Miaſma's* cannot ſtop Reſpiration, unleſs they are mixed with the Blood; for I ſee no Proof of that, nor any Reaſon why their Mixture with the Blood ſhould occaſion Death. Now we know that theſe *Miaſma's* are joined with a greater or a leſſer Gravity of the Air, which produces a greater or leſſer Inflation of the Lungs than in their natural State; and from that alone this Defect of Reſpiration proceeds.

The third Argument is taken from an Experiment of Dr. *Mayo*'s, ſhewing that the Blood, when it has been emitted for ſome time, and freed from the Air in the Air-Pump, does not expand it ſelf ſo much, as the freſh drawn Arterial Blood does in the ſame Engine, and by conſequence does not contain ſo much Air. But nothing certain can be concluded from this Experiment, unleſs it be firſt proved, that the following Propoſition is falſe.

Upon the Expoſing of two equal Portions of the ſame Fluid, both abounding with an equal Weight of Air mixed in their ſmalleſt Spaces, a greater Quantity of Air may be extracted in the ſame time from that Portion of the Fluid, which is divided into ſmaller Parts, than from that which is not ſo much divided, provided the ſame Force be applied to both.

The Truth of which Propoſition is ſelf-evident; for it is plain, that a Fluid of a cloſer Texture, *cæteris paribus*, cannot ſo ſoon, or with the ſame Force, be compelled to diſcharge the Air included, as one of a looſer Texture; and we ſhall prove hereafter, that the Arterial Blood is of a looſer, and the Veinous Blood of a cloſer Texture.

This laſt Argument depends upon the Authority of *Sylvius* and *Thurſton*, who affirm, that Air and a black ſort of Fluid was impelled thro' the *Trachea* into the Blood-Veſſels of the Lungs. I ſhall reply to this from an Obſervation of *Malphigius*'s, who diſputing of theſe kinds of Argument in his 1*ſt* Epiſtle *de Pulmonibus*, concludes thus. *From whence, as there is no natural Paſſage from all theſe Veſſels, becauſe the immitted Liquor makes more Paſſages for it ſelf, than are uſual in a State of Health; ſo we are convinced, that thoſe direct and glorious Roads are broken, upon any ſlight Impulſe, and Alteration of the Humours.* And indeed it is evident to any one who trys this Experiment with Care, that it is impoſſible but the Veſicles, and thoſe Veſſels of the Lungs, whoſe Texture is ſo delicate, muſt be burſt by the Force, with which the Air, and that black ſort of Fluid, is immitted into them.

Theſe are all the Reaſons, and all of one Stamp, which are equally favourable to Dr. *Mayo*'s Hypotheſis, as to *Borellius*'s and *Etmuller*'s.

9. Becauſe he, agreeable to *Willis* and many others, determines, that the Air ſupplies the Blood in the Lungs with *Nitro-aerial* Particles, as he expreſſes himſelf, which Particles meeting with others of a *Salino-ſulphureous* Nature ſupplied from the Blood, excite that Efferveſcence, upon which Muſcular Contraction depends; and which by conſequence make a great part of the Animal Spirits.

From hence he concludes, that Animals die, upon the Suppreſſion of Reſpiration, for this Reaſon, becauſe upon the want of that Salt of the Air, the Motion of the Heart flags, and then the Flow of Blood to the Brain is interrupted, and of courſe the Diſtribution of the Animal Spirits, wherein the Foundation of Life is placed, ceaſes. But I ſhall not inſiſt any longer in the Refutation of theſe, but only obſerve, that the Opinions which we have enumerated, which ſeemed new to the Authors themſelves and others, ought to be accounted one and the ſame Hypotheſis expreſſed in different Terms; ſo that whoever refutes one, refutes them all.

10. For it amounts to the ſame thing, whether we affirm with *Etmuller*, that Part of the Air is mixed with the Blood in the Lungs for the Service of Reſpiration; or with *Borellius*, for the Preſervation of the Oſcillatory Motion; or with *Wedelius*, for the Continuance of the Reciprocation of two different Kinds of Air; or with *Bohnius*, for the ſupply of the Blood with ſpherical Particles; or with *Mayo*, with nitrous Particles of Air; both which, according to theſe Authors, are the Cauſes of its Elaſtic Quality, which indeed it has not: Becauſe all theſe Opinions determine, that ſome Part of the Air is neceſſarily conveyed into the Blood by the Aſſiſtance of Reſpiration. But the Reaſons drawn from the *Phænomena* are general,

and prove that no Part of the Air, under any Denomination, enters the Veſſels of the Lungs for the Service of Reſpiration: For not one of theſe can ever, from their particular Opinion, explain, how it happens, that the *Fœtus* lives without Reſpiration in the Womb, but that the Animal out of the Womb dies without Reſpiration, altho' it is ſupplied with Blood from a reſpiring Animal, which Blood is impregnated with a Part of Air either *Elaſtic*, or *Perſpirabile*, or *Recipocrative*, or *Spherical*, or *Nitrous*. See *Phænomenon* the *6th*.

But theſe Great Men, offended againſt the Rule laid down at the Beginning of this Diſſertation, becauſe they had recourſe, without Reaſon, to Properties of the Air not ſufficiently underſtood, much leſs demonſtrated, when the Gravity and Elaſticity of the Air ſeemed ſo plain and obvious to all, which they ſhould rather have examined into, and adapted to the Buſineſs, than have entangled themſelves with inextricable Difficulties.

11. We muſt now repeat our former Obſervation, that the Air, in which the included Animal dies, has neither loſt its Gravity nor Elaſticity; and therefore, that all the Air, which was there at firſt, remains there ſtill, and by conſequence from a known Property of the Air, that no Air, or Nitro-aerial Particles, are drawn by Reſpiration into the Blood-Veſſels of the Lungs.

Beſide, it is evident from the firſt *Phænomenon*, that the Air, or whatever Body it is which is to be drawn into the Lungs for the Conſervation of Life, cannot penetrate the Coat of the Lungs; otherwiſe an Animal might ſurvive a long time after the opening of the *Thorax*, neither would the Lungs fall together; and when the *Thorax* was ſhut, the Air, by running from the Branches of the *Trachea* and the neighbouring Veſſels into the Cavity of the *Thorax*, would continually obſtruct the Inflation of the Lungs, and Reſpiration it ſelf; ſince the Air is a Fluid which preſſes every way. Again, it is evident that the Air, which could break the Sides of the Veſſels in the Lungs, would break the Sides of the Veſicles too, and the Coat of the Lungs, in which they are involved, and which forms a ſort of Net-work there: But upon this Suppoſition there could be no Inflation of the Veſicles, and no Reſpiration performed. But that no one may imagine, that the Blood is conveyed into the Veſſels of the Lungs, to receive the Air there, let us remember, that we endeavoured to prove in another place, that the Ducts of the Arteries and Veins were continued Pipes; and indeed were they not continued in the Lungs, we ſhould always eject Blood with the Air. But perhaps it may be of ſome uſe to the Confirmation of this Truth, ſince others disbelieve it, becauſe they have not ſeen it, to quote *Malphigius*, where, in his *Second Epiſtle de Pulmonibus*, he ſays, that the Blood, (as is plain to Senſe it ſelf) runs thro' Veſſels of a winding Nature, and is not diſperſed into an open *Areas*, but is ever forced along thro' Pipes, and Conduits.

12. But not to be ſo tedious in the Demonſtration of ſo eaſy a Matter, let the ſixth Phænomenon be ſufficient: For if any kind of Mixture of the Air with the Blood is ſufficient for the Preſervation of Life, then the Blood drawn from a reſpiring Animal, or Milk immitted into any Veſſel where a non-reſpiring Animal lies, would give and preſerve Life to that Animal, after the ſame manner as the maternal Blood does to the *Fœtus*, ſince Milk bears an equal Portion of Air, endued with an equal or a greater Gravity, and ſo the Animal would not die, which contradicts the ſixth Phænomenon.

But the particular Proof that the Air does not enter the Pulmonary Veſſels, depends upon the 2*d* and 3*d* Phænomena; where it appears that there is Air enough to enter the Veſſels, if there was any Poſſibility that it ſhould enter. And that it does not enter, is plain from the 8*th*, ſince after the Death of the Animal, whoſe Noſtrils are not cloſed, the Air is found in the Veſſel in which it was included with the Animal of the ſame Gravity, as when it was at firſt inſpired;

and included. The Cauſe of which Phænomenon we ſhall take this Opportunity of explaining. We obſerve, that the Air does not enter thro' the Pores of the *Pleura* of the nervous Circle of the *Diaphragm*, becauſe it finds a more eaſy Paſſage thro' the Mouth, and the wide Duct of the *Trachea*, where it meets with a leſs Reſiſtance. After the ſame manner the Air admitted into the Lungs, finds a more open and leſs obſtructing Paſſage thro' the Mouths of the Veſſels leading to the *Trachea*, than it does thro' the Sides of thoſe Veſſels which are adapted for the Maintenance of a watry Fluid, of a thin Texture, and warm Nature, and ſo is drove by a leſs Force toward the Jaws than into the Veins, that is, the ſame Force which is ſufficient to drive the Air towards the Jaws and Mouth, is not ſufficient to drive it into the Pores of the Veins, which are neither ſo open as the Jaws, nor fill'd with a Fluid which is capable of making ſo little Reſiſtance. And the Force of this Reaſoning depends upon this, that the Air is an Elaſtic Fluid, expandible to all Parts, and therefore will be ſooner, or eaſier drove thro' larger Paſſages, and where there is a leſs Force of an expanding Heat, than it will thro' much ſmaller Paſſages, where there is a much greater Heat, which makes the Compaſs of the Aerial Parts too great, and encreaſes the Diameter. And this is ſo evident,

dent, that after the Air is once admitted thro' the *Trachea* into the Lungs, and partly by its Weight, partly by its Elaſticity drove into the Veſicles, it can never afterwards be returned entire ; but it will leave ſome part in the Veſicles of the Lungs, eſpecially in the extremeſt, which can never be imbibed by the contiguous Veſſels ; and the Lungs themſelves which are ever afterwards more inflated and lighter than they were in the *Fœtus*, plainly demonſtrate that there is not room for the minuteſt Particles of Air to eſcape into the Blood-Veſſels of the Lungs.

13. It now remains that we explain, what Alteration that is which is made upon the Deſcent of the Air into the Lungs, which is neceſſary to Creatures after their Birth and the firſt Act of Reſpiration, and yet is accounted unknown and uſeleſs to the *Fœtus*. In a *Fœtus* almoſt all the Blood circulates from the *Vena Cava*, and pulmonary Artery, into the pulmonary Vein, and the *Arteria Magna*, without any regard to the Lungs themſelves. For the Lungs uninflated, admit of but a ſmall Quantity of Blood. Becauſe, ſince the Veſicles of the Lungs upon an Inflation become Sphærical, when that Inflation ceaſes, they will change to Sphæroides, and being of an oblong Figure, grow flaccid of courſe : But at that time theſe Veſicles may, and ought to be touched by all the contiguous Veſicles round them, and the

Blood-Veſſels in which they are involved, will be compreſſed and cloſed. Beſide, the Branches of the *Trachea* are placed at Right Angles with the lower *Trachea*, and at obtuſe ones with the upper; from whence it happens, that theſe *Branches* (when there is no Inflation) and the Veſſels annexed to them, will forcibly compreſs the lower and interiour Branches and Veſicles; and ſcarce any Circulation at all can be performed thro' the Lungs uninflated. Wherefore ſince the Veſicles in this State of Compreſſion make a greater Reſiſtance to the Blood, that pours from the Left Ventricle of the Heart, than that open and uncompreſſed Paſſage, which leads from the Riſe of the Pulmonary Artery to the Riſe of the *Aortal* Artery; it is neceſſary that almoſt all that Blood, which paſſes by the Orifice of the Veinous *Anaſtomoſis*, ſhould enter into the other, or the Arterial *Anaſtomoſis*, which will eaſily admit of it. But altho, by its being proved, that very little Blood paſſes thro' the Lungs in a *Fœtus*, it follows too that the *Fœtus* does not reſpire by an alternate Draught and Return of the Air thro' the *Trachea*; yet this Truth will appear more plain, when we conſider ſome other *Phænomena's*: For the Air does not penetrate the Secundines; and altho' ſome Air was originally included in them, yet Reſpiration could not be maintained by that, as is manifeſt from the Experiment of an Animal included in a Veſſel impervious to the Air.

14. The Lungs then of a *Fœtus* continue uninflated merely from a Defect of Air, that is, ſuch Air as living Creatures draw in with Freedom: For, ſince the Lungs do not adhere to all the Ribs, and where they do adhere, the Lobes may perhaps be diſtended, but the ſmaller Lobes and Veſicles will not dilate, altho' the Breaſt of the *Fœtus* encreaſes, unleſs there be a ſufficient Fluid to make that Dilatation, and of which there muſt be a conſtant and freſh Succeſſion, as the Nature of Reſpiration, explain'd by theſe *Phænomena's*, requires. But neither of theſe can be obtained in the Womb; But as ſoon as the Animal is produced, and has drawn in the Air, the Lungs and its Veſicles are immediately dilated; and then, as a certain neceſſary conſequence, which we ſhall ſoon explain, the Circulation thro' the Paſſages proper to the *Fœtus* ceaſes, and the whole Courſe of the Blood is turned into another Road. Nor could the Cloſure of thoſe private Paſſages be prevented, if the *Fœtus* in the Womb had received the Air into the Lungs, as we ſhall ſoon prove. The Air then, immediately after the Birth, being driven by its Weight and Elaſtic Force, ruſhes into the Mouth, and the *Aſpera Arteria*, as into Places where it finds the leaſt Reſiſtance; and then at laſt the Breaſt is ca-

pable of being dilated, and elevated, after the Air by its Paſſage thro' the *Trachea*, has begun to ſupport it; and being preſſed by the Force of the circumambient Air, propels outwards with an equal Force.

15. The Air, I affirm, will ruſh in by the Force of its Elaſticity and Gravity, not by any prior Dilatation of the Breaſt. But, upon the Reception of the Air into the *Trachea* of an equal Force to the external Air, the *Thorax* will not only be capable of, but will exert an immediate Dilatation; ſince *That* is moved by a Muſcle which has no Antagoniſt, as the next Paragraph ſhall explain. But the received Air being heavy, and Elaſtic, will preſs equally on the Sides, as well as to the Bottom, and by conſequence will neceſſarily break into the lateral Branches of the *Trachea*; and becauſe they are ſituated at acute Angles with the lower Trunk, and at obtuſe ones with the upper; therefore if the *entring* Air is of a ſufficient Force to inflate the Branches and Veſicles, it is impoſſible but that upon the Encreaſe of their Breadth, their Length muſt at the ſame time be diminiſhed; that is, it is impoſſible but that the Branches of the *Trachea* muſt be protruded upwards, and outwards, and ſo forced to make Angles leſs acute with reſpect to the inferior Trunk. Beſide, if the *entring* Air can diſtend theſe Branches and the contiguous Veſicles by its Elaſtic Force, it will

preſs the Branches of the *Trachea* too on all Sides from the internal Superficies: And becauſe there is a greater Reſiſtance towards the *Trunk*, and the middle of the *Thorax*, which are therefore Parts of a leſſer Angle (ſince there all the Branches and Veſicles, both the inner and lower, from the ſame Side of the *Mediaſtinum*, and all the inward and outward of the oppoſite Side, make a Reſiſtance) but there is a leſſer Reſiſtance towards the Ribs, which already give way, and the exterior Branches and Veſicles, none of which, beſide thoſe of the ſame Side, can make any Reſiſtance, and which (I ſpeak of the Exteriors) are extruded by all the middle ones on each Side; therefore while the Branches and Veſicles are filled with Air, they are thruſt out together towards the Parts of the greater Angle, from whence the Cavity of the Breaſt will encreaſe and ſwell; the Branches of the *Trachea* being ſeparated, and giving room for the Inflation of the Veſicles of the Lungs.

16. Upon an Inflation of the Veſicles of the Lungs, the whole Maſs of Blood may eaſily circulate thro' the Veſſels, which are interwove, and diſperſed between them. For ſince upon an Inflation they become ſpherical, they cannot be preſſed in this State of Inflation by any neighbouring Veſſels equally inflated, excepting in a few and very minute Parts: Wherefore almoſt all the Veſ-

ſels will have no Preſſure, and the Blood will run more eaſily and in a greater Quantity from the Right Ventricle of the Heart into that Part of the Pulmonary Artery, which being extended beyond the oblique and leſs capacious Riſe of the *Arterial* Paſſage, leads directly into the Lungs, ſince there is a leſs Reſiſtance there, becauſe the Weight of the flaccid Veſicles is removed, and the other Veſſels were before turned back upon themſelves. And therefore the Blood paſſing more freely thro' the Lungs into the Pulmonary Vein, will eaſily cloſe up the Veinous *Anaſtomoſis*, by its continual working againſt the Valve, which lies oppoſite to the Blood that is to return into the *Vena Cava*; and that Valve being preſſed with an equal Force on each ſide, will ſoon grow immovable, and deny any Paſſage at all to the Blood.

But the Air, when once inſpired, muſt always be expired and inſpired by turns, thro' the whole Courſe of Life; which ariſes from a Neceſſity eaſily to be accounted for. For ſince the *Thorax* is furniſhed with attollent and dilating Muſcles, which are of ſo great a Force in reſpect of their *Antagoniſts*, that they may be accounted as none; therefore the Muſcle, or Series of Muſcles, that dilate the *Thorax*, may be ſaid to want an *Antagoniſt* Muſcle. Wherefore, as ſoon as the *Ribs*, which fall together both by their Weight and Structure, have re-expelled the Air out of the *Thorax*, the Muſcles that dilate the *Thorax* will be immediately contracted; ſince the Animal Spirits, which then effectually endeavour at a Contraction, flow alternately into Muſcles that have no *Antagoniſts*; which alternate Fluxion they exert into all the Muſcles upon account of the alternate Preſſure of the Brain, ariſing from the Dilatation of the Arteries which beat there: But this is without any Effect, where there are equal oppoſite Muſcles, and of an equal Contraction, from the ſame Cauſes.

17. While the inſpired Air inflates the Lungs, and allows the whole Maſs of Blood an eaſy Paſſage to them, if it becomes altered from any Cauſe, (either from the Encreaſe of its natural Gravity, or of its Elaſticity, or from the accidental Acceſſion of a greater Weight of ſome Bodies, which it is a Vehicle to) ſo as to diſtend the Veſicles of the Lungs too much, that is, to ſuch a degree, that the Blood-Veſſels interwoven with the Coats of the Veſicles, are much ſtraighten'd and compreſſed; then the Veſſels will be cloſed up, and the Courſe of the Blood thro' the Lungs will be obſtructed. Wherefore the Inſpiration is the Cauſe of the Dilatation of the Breaſt and Explication of the Lungs, as it is of the free Circulation of the Blood, while it pours from the Right Ven-

tricle of the Heart into the Lungs. But upon a Re-depreſſion of the Ribs by the Force of their own Weight, and, as the Great *Bellini* expreſſes it, by the aſſiſtance of their Figure, Poſition, and Articulation, the Veſicles of the Lungs are neceſſarily compreſſed, and forced inwards upon themſelves, and the Branches of the *Trachea* are impelled at Right Angles: In the mean time the Air included in the Veſicles is expelled towards the Paſſages of the *Trachea*, and the Jaws. But ſince the Air is an Elaſtic Body, it cannot be expelled without preſſing upon all the adjoining Parts; which is the Reaſon that the Blood, in its paſſage thro' the Coats of the Veſicles, is more forcibly driven to the Left Ventricle of the Heart. And becauſe this Blood paſſes thro' an infinite Series of Veſicles, which are compreſſed by the Fall of the Ribs between innumerable ſmall Bodies, and is drove by the Force of the Air in the minuteſt Veſſels; therefore every Particle of the laſt-formed Blood is ſo broken and comminuted, ſo ſeparated from each other, or reduced to ſo ſmall a degree of Coheſion, that it is eaſy for any one Particle to paſs off into ſome ſecretory Veſſel anſwerable to its Bulk, whereſoever it finds a leſs Reſiſtance than it does within the Blood-Veſſel which conveys it: From whence it appears, that during a regular Reſpiration no Animal has any occaſion for a *Ferment* to work its Secretions. But after the Air is ejected out of the Veſicles, the Blood is no longer comminuted by its Elaſtic Force, and the concurrent Powers of the *Ribs* endeavouring to reſtore themſelves; and all the remaining part of Expiration is ſpent in the Excluſion of the Air.

18. It is hardly worth while to explain at preſent, why Air of ſuch a Levity as is inſufficient to cauſe a ready Inflation of the Veſicles of the Lungs, and at the ſame time to recline the Branches of the *Trachea* at obtuſe Angles, will not anſwer the Neceſſity of Inſpiration: Nor why, in a cloſe Veſſel full of Air, where there is only a leſſer Expanſion from the Heat (for where the Heat is great, and the Place open, Reſpiration is obſtructed for almoſt the ſame Reaſon as it is in *Vacuo*, as we ſhall ſoon prove) yet the Elaſticity of the Air, and the Inflation of the Branches and Veſicles of the *Trachea*, is neceſſarily encreaſed, as is obſervable upon the opening of Animals which die in that Condition; and thus Reſpiration is ſtopped together with the Circulation; beſide, that the Air is then made more denſe and heavy, becauſe it is extraordinarily impregnated with the Particles perſpiring from the Lungs and the Skin: Nor need we enquire why Animals die immediately in *Vacuo*, upon the Failure of Reſpiration, ſince there is no Air to inflate the Lungs; tho' younger and newborn

born Creatures die ſlower in this Caſe than the Adult, becauſe the private Paſſages of the Blood are not entirely cloſed up in the Younger; as from the ſame Reaſon, upon the opening of the *Thorax* in both, amphibious Animals, that is, thoſe, all whoſe Blood does not paſs thro' the Lungs, do not die ſo ſoon from the Defect of Reſpiration, as thoſe, whoſe whole Quantity of Blood does paſs thro' the Lungs.

I had rather now explain the Reaſon, why a *Puppy*, tho' its private Paſſages are ſtill open, if it once has admitted the inſpired Air, and the *Trachea* be then immediately cloſed, and remain ſo, ſhould yet die ſlower than a *Dog*. For upon the Cloſure of the *Trachea*, from the ſame Reaſon in both Caſes, a Portion of Air is included after Inſpiration, which is expanded to ſuch a degree by the Power of the Heat, that now no Blood can paſs thro' the Veſſels of the Lungs, as being too much compreſſed by the Air. In this caſe then, it is neceſſary for the Prolongation of Life, that all the Blood ſhould paſs thro' thoſe old private Paſſages, which it cannot now, nor indeed ever did before; wherefore there is Neceſſity for the Death of the Animal in both Caſes; but the Puppy will die more ſlowly, becauſe the private Paſſages, which allow room for ſome little Circulation, ſtill remain open. But if the Portion of the included and expanded Air be not ſo great, as to lock up all the Paſſages of the Blood into the Lungs, the Animal will ſtill ſurvive the longer.

But if the *Fœtus*, either within or without the Membranes, is manag'd ſo, as to have no Power of Reſpiring; yet ſtill it will be longer in dying than an Adult, while both the old Paſſages are open, and the Veſicles of the Lungs uninflated with Air; nor will it die, but by the Defect of Nutriment, or the Force of the Cold, and then only as a Creature, whoſe Nature can bear neither of thoſe Extremes.

I ſhall take an Occaſion to enquire in this place, what Power that is in *Lightning*, which ſo ſuddenly extinguiſhes Reſpiration. The *Thorax* of a Youth, who was killed by *Lightning* about two Years ago at *Edinburgh*, was opened in my Preſence, when I had an Opportunity of judging, whether my Conjecture was right, which affirmed that the Lungs of the dead Perſon in this Caſe were flaccid, like thoſe of Creatures that die in *Vacuo*, in the Air-Pump of *Guerikius* or *Boyle*: and then we could find nothing extraordinary, or which ſeem'd to affect the Life, but that ſtrange *Collapſus* of the Lungs: the Hair and Clothes indeed ſeem'd ſing'd and burnt. Wherefore, the Air which ſurrounded the Perſon, being ſuddenly and to a great degree expanded, could not inflate the Branches of the *Trachea*, becauſe its Gravity was leſſened, nor could it enter the Veſicles, becauſe the Expanſion of its Parts was encreas'd. Nor did the *Phænomenon* of that ſudden Death make me recur to framing new Properties of the Air, or calling in the Aſſiſtance of other Bodies unintelligible both to my ſelf and others.

19. It appears then from what has been proved, that the *Fætus* can live in the Womb without Reſpiration, ſince there are Paſſages open (altho' the inflated Lungs keep theirs ſtrictly ſealed) by which the Blood can circulate from the *Vena Cava* into the *Aorta*, in which Circulation the Animal Life ſubſiſts. But the Infant, tho' born before the ſeventh Month, immediately reſpires, nor can it ſubſiſt any time without Reſpiration; becauſe, unleſs the Mouth and Noſtrils are cloſed, the Air will ruſh by its own proper Force into the Breaſt, which thro' the whole Courſe of Life afterwards muſt be alternately dilated and contracted; and then the Lungs are inflated, and the Blood flows freely thro' them, and cloſes up the *Veinous Anaſtomoſis* after the manner we before deſcribed; and for the ſame Reaſon, as it flows with a greater Gravity into the Left Ventricle, it neceſſarily cloſes the Arterial Canal, which oppoſes it ſelf to the Blood which is flowing from thence into the *Aorta*. And therefore, after the Animal has once reſpired, and the Anomalous Motion of the

Blood ceaſes, it cannot ſubſiſt any time without Reſpiration, becauſe that then at laſt, upon the Cloſure of the *Anaſtomoſes* ſo frequently mentioned, the Blood cannot circulate, unleſs Reſpiration be performed by the Inflation of the Lungs. But I would have it obſerv'd in this place, that, while the whole Maſs of Blood did not paſs thro' the Lungs in the *Fœtus*, there was an evident Neceſſity for the Diſperſion of a greater Quantity of it thro' the *Viſcera*, and the Veſſels interwoven beneath the Skin; wherefore they were all more full of Blood, and the Skin appeared of a more ruddy Complexion, and the Brains of the *Fœtus* were larger: All which *Anomalies* ceaſe by degrees in born Creatures after Reſpiration, by the Explication of the Lungs, and the large Encreaſe of the Vital Paſſages.

20. Before I go on to explain any farther Uſes of the Lungs in born Animals (for the Lungs are given for a future Service to the *Fœtus*, if it once make its way to Light) it is neceſſary for me to anſwer the Objections againſt the Hypotheſis which we have advanced, which is, That-Life conſiſts in the Circulation of the Blood, produced by the Motion of the Heart and Arteries; and that therefore Reſpiration is neceſſary to born Animals, becauſe without that the Circulation cannot be performed. For it is not only *Pechlin*'s Opinion, that an inteſtine Motion

of the Blood, which many ſuppoſe a Property in Fluids equally compreſſed on all ſides, has a neceſſary Connexion with the Life of Animals. *Pechlin* would have this Motion preſerved by the Entrance of the Air into the minuteſt Paſſages of all the Parts. And altho' the Circulation of the Blood, and even of the Animal Spirits, ſhould ceaſe in the mean time, yet he imagines that Life would be ſtill preſerved, in the 3*d* Chapter of his Book *de aeris & alimenti defectu.* But every one knows, that when the Motion of a Fluid is once deſtroy'd, it can never be recovered or reſtored by the Motion of the Parts of a Fluid, or by any other Parts breaking in equally on all ſides on that Fluid, with a Motion round their own *Axes* (for this, or ſomething like it, is what theſe Authors mean, as *Pechlin* expreſſes himſelf in the 1*ſt* Chapter and 18*th* Page of the ſame Book.) And therefore *Pechlin* endeavours to no purpoſe to prove, that thoſe Animals which ſeem dead to us in the Winter, and which we find afterwards to be really alive, have loſt the circular Motion of the Blood from the Arteries of the Veins, which the Spring, by the aſſiſtance of the *Inteſtine* Motion, and the Application of a more kindly Air, reſtores. The ſame is as ineffectually attempted by others, by drawing Inſtances from ſome Diſeaſes, where Reſpiration and the *Pulſe* ſeem extinguiſhed and deſtroyed, while the Life is ſtill continued.

21. Let this Obſervation ſuffice to anſwer both Inſtances. Suppoſe a Breaſt of a ſpheroidical Figure, let the leſſer Diameter be fifteen Inches, and the greater twenty Inches. It is proved by others, that upon the Dilatation of the Breaſt the leſſer Axis is encreaſed, and at the ſame time the greater not diminiſhed, and therefore the Cavity and Amplitude of the Breaſt becomes larger. Suppoſe the Encreaſe of the Diameter reaching from the *Spina Dorſi* to the *Sternum* the tenth Part of an Inch, and the Encreaſe of the Cavity of the Breaſt will be 31 Cubical Inches, and the Breaſt may and will receive ſo much Air, being dilated to that degree, as to have its leſſer Diameter encreas'd the tenth Part of an Inch. In the ſame manner, if the Encreaſe of the leſſer Diameter is the fifth Part of an Inch, the Breaſt will receive 62 Cubical Inches of Air. But if the Augment of the Diameter is the 50*th* Part of an Inch, the Augment of the Cavity of the *Thorax* will be ſix Inches; and if the Augment were only the 100*th* Part of an Inch, the Increaſe of the Cavity would be three Inches: and ſo much Air would be drawn in for the Explication of the Lungs, and therefore in that caſe they would be a little expanded. From whence it appears, that ſome Reſpiration may be performed, if the Encreaſe of the Diameter of the Breaſt is but very ſmall, and the Motion ſcarce perceptible.

tible. But, if at the ſame time the greater Diameter of the Breaſt ſtretching towards the *Abdomen*, is encreaſed but in the leaſt proportion (as it always happens in every Act of Inſpiration, upon account of the Motion of the *Diaphragm* towards the Parts of the *Abdomen)* then a ſufficient Quantity of Air may ruſh into the *Thorax*, and yet no Motion at all be obſerved in the Breaſt.

From theſe and the like Inſtances we may be aſcertained, that ſo ſmall a Motion of the Breaſt, as is imperceptible to the Eye, does not obſtruct Reſpiration and the Circulation of the Blood, that inſeparable Attendant of Human Life.

22. Let us now apply our ſelves to that Diviſion and Solution of the Parts of the Blood, which is not obtainable either in the *Viſcera* or the Lungs uninflated, but is entirely owing to the Inflation, and which is the Cauſe of the greateſt Difference of Strength and all other Powers between the *Fœtus* in the Womb and the Animal after the Birth, and is of the greateſt Uſe and Service to Life.

While the Air is expired, it is evident that the oppoſite Sides of the Sections of the Blood-Veſſels are ſuddenly reduced almoſt to a Contact; by which it is impoſſible but that the Parts of the Blood muſt be ſo ſeparated, that not any two ſhould cohere, nor any heavier Particle be joined to a lighter: and be-

becauſe it is only requiſite for the Performance of Secretion, that the Particles to be ſecreted ſhould not be larger than the Mouths of the Secretories, or if leſſer, yet not too many, nor of too cloſe a Coheſion; it follows, that upon the Comminution of the Particles of the Blood, which happens when the Lungs are inflated and the Air expiring, that Advantage muſt be obtained, that the Blood without the unintelligible Aſſiſtance of Ferments ſhould diſcharge the Offices of all Secretions, and of conſequence perform all that is neceſſary for the Life and Convenience of Animals.

23. By the aſſiſtance of theſe Obſervations we may give a better Reaſon than Dr. *Lower*'s for the Variety of Colours in the Blood. Upon an Inflation of the Lungs, the ruddy Particles of the Blood, being lighter than the others, are neceſſarily more ſeparated from the reſt; from whence is derived its florid Colour in its Paſſage to the Left Ventricle, and of its Superficies immediately after Veneſection; the red Particles ſwimming at the Top by their natural Levity, or endeavouring at it where there is the leaſt Reſiſtance, by their Elaſticity, if they have any.

Beſide, from hence another *Phænomenon* is eaſily explained, why the Blood, which upon its being poured into a deep Veſſel, is often of a dark Complexion, tho' expos'd to the Air, and yet when poured into a wide and ſhallow one, it ſeems florid: For, if there are any ruddy Particles in it, which have not as yet diſengag'd themſelves, they will more eaſily emerge thro' a few Superficies, than thro' an innumerable quantity, and thoſe of a greater Gravity. In the laſt place, from hence we diſcover the Cauſe, why a Viſcid Blood, that contains ſome ruddy Particles entangled in it, altho' it is expoſed to the Air, is not for the generality ruddy and florid (tho' it was of that Complexion upon its firſt Emiſſion from the Veins) after it has loſt that Motion which was the Cauſe of its Non-Coheſion, which it enjoyed in its proper Veſſels.

24. I will only add, that by the Conſtriction of the Blood-Veſſels in the Lungs, the larger and laſt-compounded Particles of the Blood are divided and ſeparated from each other, and that the ſame Cauſe neceſſarily makes the Parts of the leſſer ſeparated Blood of a cloſer Texture, and more difficultly reſolvable into their firſt Elements. It is not now worthy of our Pains to examine curiouſly the Opinion of the Excellent *Malphigius*, who affirms, that a new Mixture, and new Figures agreeable to the Pores of the Parts, commence here; becauſe our former Proofs evince it to be impoſſible, that ſuch a Mixture or Confuſion ſhould be made in the Lungs, when there is only a Separation of Parts, unleſs he means that Hardneſs

and ſtricter Coheſion of the leſſer Parts, which we mentioned before: But for my part, I can ſee no Neceſſity nor Uſe for new Figures in this caſe.

22. And thus much I have writ with this View, to inform the Students in Phyſic the Uſefulneſs of the Rule laid down at the Beginning of this Diſſertation, how many *Phænomena's* may be explained by a few known Qualities of Bodies: And I would adviſe Phyſicians not to think that they have diſpatch'd a Problem well, by recurring for a Solution of it to Figures of all kinds, ſubtle Air, and oppoſite Kinds of Salts, and Bodies of which we know not ſo much as the very Names, and inteſtine Motions, and other Terms of a vain and pompous Ignorance.

* * *

A
DISSERTATION
UPON THE
Motion which reduces the Aliment in the Stomach to a Form proper for the Supply of the Blood.

WE all experimentally know that the Bodies of Animals loſe their Forms by Hunger, and an Abſtinence from Food, that the Veſſels grow flaccid, and the Juices adapted to recruit the Circulation of the Blood fail in their Office, and in one word, that Animals die. It is as plain too by Experience, that the Parts of the Fibres, Fluids, and Veſſels that make up the Form of an Animal Oeconomy, ſuffer even in the ſoundeſt Bodies by Motion, that they are diſunited, wore away, and impaired; and that by the Force of the natural Circulation of the Blood, that is, by the very Conditions and Laws of Life it ſelf, Death becomes neceſſary; and hence is cauſed that continual Perſpiration thro' the ſudorific Veſſels, and the Pores of the Skin: Since, as we explained it in another Diſſertation, all Secretion is made merely by the Force which the Heart impreſſes upon the Blood, which compels all Fluids to endeavour to paſs' thro' thoſe Parts where there is the leaſt Power of Reſiſtance. Wherefore, if we regard only that continual Perſpiration, it is plainly neceſſary that there ſhould be a Supply of Fluids to the empty, and an Addition of Parts to the decay'd Veſſels in ſuch a Proportion, as, either upon a Trial by Weight we ſhall find is loſt, as the excellent *Sanctorius* adviſes, or upon our own Obſervation of the Diſtances of Time, as Hunger induces the Generality to practice. From whence it follows, that the Conditions required for the Supply of thoſe Diminutions of the Body, are a Fluid diſpoſed to Sanguification, and a Compound of Particles ſimilar to the Compound which is decayed; which is neceſſary if we ſuppoſe the Animal to continue like it ſelf.

2. But it is evident to any one who regards thoſe Operations which the Anatomy of the Body, and the Actions of Animals demonſtrate, that the Aliment acquires in the Stomach and the Inteſtines that particular Facility of Motion, which qualifies it to

mix with the Blood. And therefore, if we can find the Nature and Quality of that Action in the Stomach, or what Similitude, or Proportion that Cauſe of the Fluidity of the Aliment in the Inteſtines bears to other Cauſes which either are, or are accounted more known, we muſt be allowed to have ſolved this Queſtion, and moſt Phyſicians ſeem to me to have erred in the Solution of this Queſtion, becauſe they did not ſufficiently underſtand what the Queſtion was. For we do not look for a Cauſe which has a Power to change all ſorts of Subſtances into a Fluid commiſcible with the Blood, and conſiſting of Parts ſimilar to the Parts loſt, (now that Similitude is an Equality of Magnitude, Gravity, and Number) but only ſuch a Cauſe as has a Power on ſome Bodies, ſuch as Mankind generally uſe for Food and Nutriment, and can convert them into a Fluid fit for Circulation. For then obſerving that there were ſome Animals which would devour and ſend into the Stomach the hardeſt Metals, and Minerals, immediately concluded that they were to find a Cauſe which had a Force to colliquate any ſort of Subſtances which were offered to the Stomach. And accordingly you may obſerve, that they have introduced into the Stomach, either certain powerful *Dæmons*, and exalted inviſible *Spirits*, or *Ferments*, and other Fluids of various Denominations, which are ſuppoſed able to diſſolve any manner of Subſtances. But had they remembred the State of the Queſtion, and that all we wanted was ſuch a Cauſe, or the Knowledge of ſuch a Cauſe, whereby certain ſolid Bodies (the common Food and Nutriment of Man) might be changed into Fluids adapted to our Nutriment, that is, into Liquids which could circulate with the Blood, and ſupply it with Parts of almoſt the ſame Magnitude, Gravity and Number, with thoſe Parts, which either by the Force of Motion, or Perſpiration, were diſperſed beyond the compaſs of Circulation, and the Courſe of the Blood: And had they in the next place obſerved, that thoſe Animals were not nouriſhed by the hard Subſtances they devoured, then would they eaſily have ſeen, that ſuch a Force only was ſought for, which could diſſolve the ſolid Parts of other Aliments, ſo as to turn to our Nutriment; or how ſuch Parts could be reduced in our Stomachs to a Fluidity ſufficient for that purpoſe. All which, if I am not miſtaken, may be explained without the Aſſiſtance of a *Dæmon*, or a *Stygian* Liquor.

3. It is plain, that what is requiſite for the moſt eaſy and ſimple Solution of this Queſtion, is, to find ſuch ſolid Bodies to be ſent into the Stomach for Nutriment, as may by the leaſt Alteration of their own Subſtance, become nutrimental to the Animal;

mal; it is neceſſary too that that Change ſhould be attended with a Facility of Motion, as is plain from the allowed Nature of a living Animal, whoſe Life and Nutriment depend upon the Circulation. Now ſince the ſolid Parts of other Animals, upon which we feed, when reduced into a liquid or fluid State, are by the leaſt Alteration adapted to nouriſh us, becauſe they bring with them Parts ſimilar to thoſe we loſe, and ſo by the Hypotheſis are adapted to Circulation; therefore it is manifeſt, that the ſolid Parts of proper Animals are thoſe Bodies which are required in the Queſtion: And therefore we are now only to look for a proper Cauſe, or what is the moſt ſimple and natural Force which can convert thoſe Parts contained in the Stomach into Fluids fit to circulate with the Blood.

And, that we may make as few Miſtakes as can be in the Search of this Cauſe, I would remark, that it ought to be ſuch, which can neither diſſolve the Stomach, nor the Fleſh of the Animal it is to nouriſh, nor ſuch as can eaſily colliquate the Parts of others by the Force of a Chymical Fire, or a *Stygian Menſtruum*, (to ſpeak in that way) for this is incompatible with the Life of the Animal; nor muſt it proceed ſo ſlowly, as that Cauſe, by which the ſolid Parts of Animals, without the Aſſiſtance of Art, and being left to themſelves, reſolve into Putrefaction.

Theſe *Poſtulata* I may juſtly claim, which however will quickly be made more evident.

4. It is but a reaſonable *Poſtulatum* of mine, to require a Cauſe able to diſſolve the Parts of other Animals in our Stomach, which cannot diſſolve the Parts of the Stomach it ſelf by that Action, by which it alters the ſolid Parts of other Bodies into Fluids; for we are not here looking for a Cauſe of ſudden Death, but a Cauſe that aſſiſts in the maintaining of Life for ſome ſmall time. From whence it is evident that there is no Fluid, neither can that be accounted the Cauſe in the Queſtion, which inheres in, or is by any means derived into the Stomach, and which, if the neceſſary Conditions are obſerved, and eſpecially the *Poſtulatum* in this Paragragh, can diſſolve, or convert the Parts of other Animals ingeſted into the Stomach, into a Fluid proper for Nutriment. Becauſe, from what we have obſerved in the former Paragraph, it is plain that ſuch a Cauſe is required, as can rediſſolve the ſolid ingeſted Parts of Animals into thoſe very Particles as near as may be, or Particles like them, out of which thoſe Parts were before formed in other Animals, upon their Separation from their Fluids. Wherefore, ſince a Fluid that abounds with a Ferment, or can by any means diſſolve the ſolid ingeſted Parts of other Animals, muſt by the ſame Action neceſſarily diſſolve the Parts of the Veſſels in

the Animal, and the Stomach in which it inheres, or into which it is derived; it eaſily follows, that thoſe Animals which we ſee are nouriſhed by ingeſted Food, without any Injury to their Stomachs, contain in their Stomachs no Ferment at all, or no Liquid which can diſſolve, digeſt, and convert into Chyle ſolid Aliment: nor would ſuch a Fluid remove the Difficulty of the Queſtion, ſince it would always remain to be explained how it ſhould happen, that any Fluid ſhould diſſolve one Subſtance into the deſired Parts, and thoſe out of which it was lately compounded, and yet ſhould not diſſolve another Subſtance into the ſame Parts, which is in the like degree, and as frequently its Subject of Operation, or which is always, and in the ſame manner expos'd to its Action; altho' this other Subſtance is compounded of the ſame Parts neither more in Number, nor ſtricter in their Union. And indeed it were miraculous, if a Liquid diſſolving and digeſting the Food of the Stomach, ſhould not diſſolve thoſe Parts, which are not more ſolid than the Food it ſelf, and which, if exſected from another Animal of the ſame Nature, and ingeſted into the Stomach, would immediately be diſſolved in it. So that we may well wonder what ſort of Solvers of Medical-Problems they were, who thought they had rightly explain'd the manner of the Digeſtion of the Food in the

Stomach, when they had not explained, nor ſo much as attempted to explain the Reaſon why, upon the Digeſtion of Food in the Stomach, which is as eaſily digeſtible as the Food, yet the Stomach it ſelf ſhould not be diſſolved. And this Queſtion is the ſame as that which thoſe famous Men had ſolved, after their way of ſolving.

5. Hence it is manifeſt, that neither a Fluid abounding with an Acid, or Volatile Body, nor a Salt, or Acrid, nor a Compound of theſe, or other Particles of any nature, are the Inſtruments of the Diſſolution and Digeſtion of Food in the Stomachs of Animals. Much leſs can this Operation be ſucceſsfully performed by the inviſible Spirits of *Helmont* and *Wedelius*, or the Dæmon of *Doleus*.

From hence we conclude too, that Digeſtion is not performed (as *John Bohnius* ſays and imagines in his *Anatomico-Phyſiological Circle)* by the aſſiſtance of a Digeſtive Liquor or *Menſtruum* derived from the Salival Glands and thoſe of the Stomach, which he calls not an Acid, but a Diluted Salt; and which, by the inteſtine and vital Motion of its Parts, imbibes and adapts to it ſelf, and ſo forms a ſort of an Extract from the Food, of a milky and mucilaginous Subſtance, agreeable to its own Nature, and proper for the Nutriment of the Body. This Perſon certainly is miſtaken in many Inſtances; but it is enough for me to obſerve, that this Liquid, or Vital Diſſolvent of *Bohnius* and *Wedelius*, and many others, can and ought, after the ſame manner, to attract to it ſelf and imbibe the diſſolvable Subſtance of the Stomach in which it inheres, and which is as agreeable to it, and ſubject to be converted into Nutriment: which ſince it does not, we conclude that neither does it perform what *Bohnius* and *Wedelius* by their *Hypotheſis* ſuppoſe, but do not prove. It is to no purpoſe for any one to make an Objection from the Roughneſs of the Superficies of the Stomach, and the Viſcous Nature of the Phlegm, which are capable of defending it from the Injuries of the Diſſolving or Corroſive Liquid, or Ferment. For the Queſtion is, how it comes to paſs that any Ferment ſhould diſſolve Fleſh, and not diſſolve Fibres, whoſe Coheſion is much weaker than that of Fleſh? Now that Viſcous Phlegm, by its entangling and blunting the ſubtle Ferment, or the Air, or digeſtive Fluid perpetually diſcharged from the Coats of the Stomachs, equally defends the Food as well as the Stomach from any Injury, and ſo ſpoils and baffles all Digeſtion.

---

* *See Page* 149 *of his* Circle.

6. And hitherto we have deliver'd only the Opinion of Thoſe, who have not hit upon a happy Solution of the Queſtion; or of

Thoſe, who have honoured a Queſtion, that bears no Relation to this, with the Name of a true Solution.

We muſt now repeat and inculcate into the Reader, that whatever Men receive and ingeſt into the Stomach for the Conſervation of Life, or the Circulation, and the Nutriment of the Body, are either Animals or Vegetables, that is, Animals of the higher or lower Claſs of Beings; ſince both these enjoy a Circulation of Fluids, and conſiſt of ſmall Pipes, and Fluids that ſupply and nouriſh thoſe Pipes. From whence it appears, that the Foods which Men uſe, and by the Direction of Nature ought to uſe, conſiſt of ſuch Parts, as exhibit the Form and Nature of Pipes, and Fluids adapted to change into ſuch Pipes. For, whatever that Action was, by which the Parts of a Fluid, that nouriſh any Veſſel or Fleſhy Subſtance, were firſt altered into the Magnitude and Figure, and other Qualities of a proper Aliment, adjoinable to that Veſſel; yet ſome Parts of the nutrimental Fluid were merely by the Force of the ſubſequent Fluid drove cloſe and adjoined to that Veſſel for its Reparation: And it is allowed by all, that Nutrition is performed by a Conjunction and Inſinuation of Parts ſecreted from a Fluid into Spaces left vacant by the Seceſſion of others of a ſimilar Bulk and Figure. And therefore it is plain, that the Parts of Animals reſolved after the moſt ſimple manner (that is, in ſuch an Order, that thoſe which cohered laſt ſhould be ſeparated firſt, and the exterior Parts firſt worked upon by an external Cauſe) will neceſſarily change into a Fluid replete with Parts proper for the Nutrition of an Animal; that is, it will change to compound a Subſtance conſiſting of Pipes, and Fluids, alterable into Pipes.

7. Again, it deſerves our Obſervation, that thoſe Subſtances, which neither compoſed the Bodies of Animals nor Vegetables, cannot nouriſh the Animal, altho' they may be changed by the Action of the Stomach; and therefore that they are not adjoined to the Veſſels for their Reparation, ſince they are not changed by the Action of the Stomach into a Fluid adapted to repair the Parts of Animals.

From whence I conclude, that nothing more is neceſſary for the Performance of Digeſtion, and the Diſſolution of the Food in the Stomach, than the Separation of ſome Maſſes and Particles from each other, which were before united into one Body, by that Action which performed Nutrition; nor have our Stomachs any other Office in this matter, than to force the Particles, united before in the Form of Veſſels and Fibres, to a Separation into their former Confuſion, or as near to that State as can be, which they enjoyed when they were to be diſpoſed for the Nutrition of the Parts; and therefore no other Force than this is neceſſary; for if any other were, and that Force can change Bodies into Figures entirely new, and all Degrees of Magnitude; then other things beſide Animals ought to contribute to our Nouriſhment.

Now ſince we are nouriſhed only by the Parts of Animals of every Claſs and Order, and ſince we have ſhown that there is no Fluid in the Stomach, whoſe Ferment prepares the Food for our Nutriment; it follows, that it is only the Motion of the Stomach working and comminuting the Food, which finiſhes Digeſtion by a Separation of the laſt-formed Parts into Pipes and Fibres of ſuch a Nature as is obſervable in Animals.

8. Becauſe it is not to be queſtioned, but the ſame Force, or one ſimilar and equal to it, by which the Parts were firſt ſecreted from an Animal Fluid into the Pores of the Body for the Office of Nutrition, ought to be ſufficient for a Reſeparation of them, and reducing them into Figures not much different from, nor much unlike thoſe which it at firſt enjoyed. But it is plain, that the Nutritive Particles, which are to be adjoined to the Parts, are adjoined merely by the Force of the Heart and Arteries propelling the Blood, and performing all Secretions, as we explained before; and there-

ſore a ſimilar Force of the Coats of the Stomach, aſſiſted by the *Diaphragm*, and the Muſcles of the *Abdomen* can rediſſolve the Maſſes ſo united into Parts, as near as may be to thoſe from which it was lately compounded; neither is there any Obſtruction to ſuch a Comminution, but that the Coats of the Stomach and the Food cannot ſo often and ſo eaſily come to a Contact in their ſmalleſt Parts, as the Parts of Fluids can: From whence it will happen, that the *Chyle* does not generally conſiſt of Parts ſo ſmall as thoſe of the Blood, eſpecially that Blood which ſuffers a new Digeſtion or Comminution in the Lungs. And there is one Particular which I deſire may be obſerved in this Place, which is, as the Force of the Blood is greater in the larger Veſſels, and thoſe ſituated near the Heart, ſo the Parts conjoined by that Force for the Nutrition of thoſe Veſſels, cohere ſo ſtrongly, that it is more difficult for the Force of the Stomach to overcome that Coheſion, than it is for it to rediſſolve thoſe Parts, which are to ſupply Nutrition in the Veſſels of a leſſer Size, and more diſtant from the Heart: For the Force is, *cæteris paribus*, more languid in the leſſer Arterial Veſſels, becauſe they are Parts of a *Cone* nearer to their Baſe: For altho' the Trunk of the Arteries is larger than any diſtinct Branches, yet it is leſs than all of them taken together; and the whole Bundle of the Arteries is to be conſider'd ſider'd as a *Cone*, whoſe *Vertex* is ſituated toward the Heart, and its *Baſe* toward the Extremes of the Body. And from hence is the Reaſon, why, in the exteriour Arteries, or thoſe more remote from the Heart, the Motion of the Blood, as it pours from narrower Paſſages into larger, is by degrees retarded; but a more languid Force is always the Cauſe of a ſlower Motion. And it is manifeſt, that this is the eaſieſt and ſimpleſt Method of ſolving the Queſtion propoſed, becauſe this makes an eaſy Liquefaction of the ingeſted Solids in the Stomach, without the aſſiſtance of a foreign Fluid; and yet, excepting the Fluidity, there is the leaſt Alteration made in the Food (as being taken from an Animal) to adapt it for the Office of Nutrition.

9. Our next Buſineſs is, to ſhew that the Cauſe we aſſign for Digeſtion, and the Solution of the Food, which is Part of an Animal Body, cannot diſſolve nor comminute the Coats of the Stomach, in which the ingeſted Food is received. For it ſeldom happens that the Coats of the Stomach come to a mutual Contact, and the Contacts that are made between the comminuting Food, and the Coats of the Stomach, are always on the ſame Parts of the Food, but from ſucceſſively different Parts of the Coats of the Stomach. However, this is the beſt Reaſon to ſolve the matter. The Diminution of the

Parts of the Coats of the Stomach, which are taken away by this Contact or Attrition, is eaſily repaired from the Matter of Nutrition, which is continually diſpatched from the Store of the circulating Blood for the Nutrition of the Parts; whereas there is no Recruit for the Parts of the Food, which are abraded by the Action of the Stomach. And hence it happens partly that Worms and other *Animalcula* live conveniently enough in the Stomach, and partly becauſe as they are alive they by their Motion withdraw themſelves from the Strokes of the Stomach, which it is impoſſible for dead Subſtances, or their Parts, to eſcape. And what is of great moment in this Caſe, if a given Body ſtriking it ſelf with a given Force on a Membrane, can perforate it, the Number of Membranes may be encreaſed to ſuch a Proportion, that the ſame Force being given, the exteriour Membrane ſhall not be perforated. Becauſe the Number may be encreaſed to that Degree, that Part of the given Force (which would not be ſtrong enough to perforate the ſingle, exteriour, unſupported Membrane) would be exerted upon the exteriour, and the other remaining Force ſpent upon the other Membranes. And ſince Abraſion is a Perforation of a Membrane, or of an exteriour Surface, which (when we ſpeak of the Stomach) is ſupported by many Membranes, the Propoſition is evident.

dent. And indeed it is plain, that the Superficies of a Beam would not be broke by the Stroke of my Finger, which however would be broke, if the Thickneſs of the Beam was leſſened, that is, the Number of its Surfaces diminiſhed. But the Thickneſs of a Body does not elude the Force of a corroſive Fluid, and the exteriour equal Superficies of Bodies of an unequal Thickneſs are diſſolved by the ſame Force of a corroſive Fluid, and in the ſame time, if other Circumſtances are equal.

10. And here ariſes a *Phænomenon*, which the Patrons of a Ferment or a digeſtive Liquid cannot tell how to ſolve. It is obſerved, for inſtance, that Digeſtion is performed better in the Stomach during the Winter, and in a cold Air, than in Summer; which can ariſe from no other Cauſe than the Encreaſe of the Muſcular Force (as at that Seaſon the Force of all the Muſcles is greater) and the compreſſive Force of the Stomach, and the *Abdomen*. But the Force of the Muſcles is encreaſed in the Winter and cold Seaſons, becauſe then the contractile Fibres become ſhorter (for which Reaſon the ſame Force will draw them into a greater Shortneſs, and cauſe a greater Inflation) from the ſame Cauſes as a Piece of Iron of any Length is found ſhorter in the Winter than in the Summer; and ſo an Iron Chain, as it grows cold, becomes ſhorter than it was

when it was hot, as is evident from Experiment. But the Completion of this Matter depends upon the different Quantity of Perſpiration: For the Excellent *Sanctorius* has informed us, in the *29th* and *41ſt* of his *Statics*, and the *ſecond Section*, that Animals retain daily about a Pound of perſpirable Matter in the Winter, which they emit in the Summer. From whence it is manifeſt, that there is an Influx of a greater Quantity of Fluids into the Muſcles in the Winter, than in the Summer, and by conſequence that this performs all thoſe Matters, which any one may in vain expect from Acids, and other Liquors, that have no place in ſound Animals, and which are foreign to that Seaſon of the Year; for the Produce of Acids is greater in the Summer, and then Liquors turn ſooneſt to an Acidity. But in this place I remark, that the Encreaſe of the *Saliva* peculiar to the Winter, belongs to, and depends upon the too great Diminution of Perſpiration. I would have thoſe take notice of this Remark, whoſe Ignorance of a Method for the Diſcovery of Truth in the Sciences, may perhaps put them upon framing new Winter Reſources of Phlegm in order to illuſtrate this *Phænomenon*.

11. For we have proved, that the *Saliva*, and whatever Fluid that is which deſcends into the Stomach, are no more fitted and adapted to diſſolve the Food, than the Su-

perficies of the Stomach, and thoſe fine Fibres, which are much more tender than any ingeſted Food, even after it has been worked by the Teeth.

But there is no Occaſion now for a curious Diſcuſſion of the Quality of the *Saliva*, that having been the Subject of every Writer, and therefore I had no Inclination to propoſe it to my Readers in this place: Neither have I thought it proper to deſcribe the Action of the Teeth, a Subject equally common, nor any other Circumſtances attendant upon the working of the *Chyle*, which Dr. *Liſter*, that moſt Learned and Candid Improver of Phyſic, has moſt happily performed, and left others only the Glory of borrowing from him. But ſince that Great Man ſeems to attribute too much to Perſpiration, which he ſuſpects to be greater in the Stomach in the Time of Winter than Summer, it is proper for us to make a more curious Enquiry into that Opinion. The Air is a Fluid, which deſcends as well into the Stomach as into the Lungs, ruſhing in whereever it finds an Entrance, whether the Heat or Cold be exceſſive: Wherefore, if the Air contributes any thing by its Winter Quality to the Diminution of Perſpiration, the Superficies of the Stomach will bear its Effects in the ſame manner as the exterior Skin. Suppoſe then, that the Winter Air obſtructs Perſpiration, the Summer promotes it, ſince both are diffuſed about the Skin, and deſcend into the Stomach, the Perſpiration of the Stomach in Winter will be to the Perſpiration of the ſame in Summer, as the Skin in Winter is to the exterior Skin of the ſame in Summer, which conſiderably exceeds the Winter, as *Sanctorius* has proved.

But the Authority of the Great *Hippocrates* introduced this Maxim, who affirmed, *That Mens Stomachs were warmeſt in the Winter* : For he obſerved that the Stomach was ſtrongeſt in the Winter ; and then aſſumed from a Sect of Philoſophy, that Digeſtion was performed by Heat ; from all which he deduced, that a greater Heat muſt proceed from the Stomach in the Winter.

12. From hence it follows, that they whoſe Stomachs abound with any Fluid in too great a Quantity or too viſcid a Nature, cannot digeſt their Food well, nor are at that time in a State of Health ; the contrary of all which would happen, if Digeſtion were performed by the Aſſiſtance of a Diſſolvent Fluid. But the Cauſe of this *Phænomenon* is widely different from any thing which the Patrons of Ferments are able to produce : for I think it is evident from what has been before ſaid, that any Fluid in the Stomach, in ſo large a Quantity, that there is no Place into which it can paſs with a ſufficient Quickneſs and Facility, or of ſo viſcid and reſiſting a Quality, as not to be ſoon and

by a ſmall Force removable from the Place that ſeparates the interior Superficies of the Stomach, and the exterior of the ingeſted Food, neceſſarily obſtructs and retards Digeſtion: For it is neceſſary upon the Interpoſition of any Fluid too copious, or too viſcid, that the Force of the Muſcles of the Stomach muſt be eluded, upon which only, ſince there is no Ferment nor Digeſtive Liquid, Concoction muſt depend.

And that ſome advantage may be made from theſe Obſervations, it deſerves our farther Obſervation, that the heavier the interpoſing Fluid in the Stomach is, it will more reſiſt the Motion of the Stomach, and both fruſtrate the Force of Motion and Contact, and ſo prevent any Digeſtion; if the Quantity of the Fluid is ſuch, as to make it neceſſarily by its own Weight diffuſed every where round the Food, as is requiſite in a Fluid which is to diſſolve and digeſt. From whence it follows, that Acid Liquors, ſince they are of a heavier Nature, and Salt too, obſtruct Digeſtion; nor is that Gravity the Cauſe why Acids are ſo difficultly removed, and carried off from the Stomach.

13. From what we have demonſtrated in the *9th* Paragraph, it is evident, that ſmall Veſſels, not ſupported by a ſufficient Number of Membranes, as the Stomach is, the oftner they reduce their oppoſite Sides to a Contact, muſt neceſſarily be oftner impaired,

and ſooner broke. For if the Veſſels almoſt fall together, while their oppoſite Coats meet with a certain Force, ſo that almoſt every intervening Fluid ſhall be ſo expelled as to leave nothing between, there will then be an Attrition of the Coats. And becauſe this is the Caſe in the Lungs and its Veſſels, as we ſhow in another place, therefore we ought not to wonder that Eroſion, and Symptoms of Eroſions, happen more eaſily and frequently in the Lungs, than in any other of the *Viſcera*. But this will more eſpecially happen to thoſe who live in a thick Air abounding with the Mineral Fumes of *Sea-Coal*, which are therefore heavier, and compreſs the Veſſels of the Lungs with a greater Force.

From theſe Obſervations we may give a plain Solution of a Queſtion which Dr. *Willis* propoſes, What is the Cauſe why moſt *Aſthmatical* Perſons breathe more eaſily in a Country Air, and yet it is more eaſy to ſome to uſe the *London* Air. The Doctor ſpeaks of his own Countrymen. It is evident, that if the Gravity and Elaſtic Force of the attracted Air remain the ſame, the ſame Animal will reſpire with an equal Facility, or the Blood of the ſame Animal will paſs thro' the Veſicles of the Lungs with an equal Facility: and if the Force of the Air continuing the ſame, the Blood does not paſs with the ſame Facility, then either the Flexility of the Veſſels,

ſels, or the Facility of the Blood in its Motion, muſt be ſo changed, that the Reſiſtance made by the Lungs muſt be encreaſed. Wherefore it is no wonder, that they who enjoy the Country Air with Eaſe and Health, cannot bear with the ſame Eaſe the heavier Air, and that of *London*, not only admitted into their Lungs, where the minute Mineral Particles conveyed in the Smoke ſtick cloſe, but alſo cannot bear it as diffuſed round their whole Bodies: nor ought it to ſeem incredible if they, who by Nature or by Diſtemper, that is, by ſome Change of Art, or the Courſe of their Lives, have their Veſſels and the Blood in the Lungs become of a more reſiſting Nature, or the former become leſs flexible, or the latter leſs fluid, can bear the heavy *London* Air better than the lighter Country Air.

From whence it is plain, how wide from the purpoſe Dr. *Willis* ſpoke upon this Subject, in the 2*d Part*, 1*ſt Section* of the 6*th Chapter* of his Treatiſe of the *Operation of Medicines*, where he aſſigns the finer Texture of their Veſſels, as the Reaſon why ſome breathe more freely in *London*, never ſolving, but perplexing the Queſtion with the Fumes of Sulphur, and ſuch Words, while he neglects the known Property of the Gravity, which is greater in thoſe Particles of *Sea-Coal* that paſs into Smoke, and are drawn in with the Air, than it is in thoſe of *Turf* and *Wood*.

14. But this Attrition does not obtain in other Veſſels, which are indeed often expoſed to the Air, but yet are ſupported, as was before proved; among which I reckon the Stomach. But the Veſſels and Veſicles of the Lungs are ſo far from being ſupported by any Structure of Muſcles and Membranes, that they are preſſed and impaired every Minute of our Lives between each Act of Reſpiration by the internal Superficies of the Ribs.

From whence it evidently follows, that it is to no purpoſe for *Wedelius*, in the *6th Chap.* of his *Phyſiologia Reformata*, to have uſed abundance of Words to aſſert, that it is demonſtrable to Senſe and the Evidence of Sight, that the Stomach contains a *Salino-Sulphureous Ferment*, and which he affirms is derived from a Vital Fluid. For if this is true, then all the Blood-Veſſels would be diſſolved and digeſted by this intercurrent Fluid (which is the greateſt Part of the Blood) by the ſame means as Fleſh and other things, whoſe Subſtances are not much harder than thoſe Veſſels, are diſſolved by the Effuſion of the ſame into the Stomach. And from theſe few Obſervations it appears, how ineffectual the Hypotheſis of an Acid or Ferment are for the Explanation of theſe *Phænomena's*, and how much eaſier it is for us to remove the Difficulties that preſs this Queſtion, by Properties which are more known, and of which we have a greater Certainty.

15. No one, I preſume, who agrees with theſe Notions of mine, will for the future have any Doubt, whether Digeſtion is performed beſt after Meals, if aſſiſted by a gentle and eaſy Walk, or ſome other unlaborious Exerciſe of the Body. For, as long as Motion ſo aſſiſts and encreaſes the Comminution of the Food by the Action of the Diaphragm, and other Muſcles, as not to force the Chyle to leave the Stomach, and enter the *Lacteals* too ſoon, that is, before the Parts are reduced to a ſufficient Minuteneſs (in which Caſe a Crudity happens, which therefore conſiſts in the Comminution of the Food into Parts of too large a Size, ſome of which however can enter the *Lacteals*) ſo long a Concoction equally good is performed ſooner, and a better Concoction in an equal Time, or, which is the ſame, there is a Diviſion of the Food made into Parts of a more proper Fluidity, and more adapted to Nutrition. For this Reaſon it is, that Digeſtion is not ſo well performed in Perſons aſleep, as in thoſe awake. And this may ſuffice for a Phyſical Explication for our firſt Concoction, as we term it, which is previous, and is celebrated much after the ſame manner, as that which we in another place attribute to the ſecond Concoction performed in the Lungs of born Animals. But we had before explained that

Concoction, of which the Third in the common Acceptation is reckoned one Part, *viz.* that Secretion, which is made in the Glands and *Viſcera*, of which Nutrition, celebrated by the Phyſician for the third Concoction, is a Species.

16. There is no occaſion now for a tedious Proof to ſhow, that after the Concoction in the Stomach and Lungs is performed, the Blood is become adapted to the Nutriment of the Animal, tho' it ſuffers no Change by a Ferment and Figures peculiar to the Parts, ſince theſe Aſſiſtances are not in Nature, or of no Uſe: It remains then that we finiſh this Subject, the previous Concoctions being made merely by the Force of the Heart and Arteries, by which any Particle of the Blood is made to paſs into ſome Place, into which it is drove by others, if the Place be capable of receiving it: And therefore ſince all cannot be expelled into Secretories, (becauſe theſe are neither ſufficient in Number, nor Amplitude, or where they are, there can be no Nutrition) or into Veſſels commonly accounted Secretories, there is a Neceſſity that ſome ſhould be ſecreted into Spaces of Fibres, which make up empty Veſſels, which yet are ſo cloſe, that the Particle which enters, and is forced onwards from behind, may come to a Contact on all ſides with more Particles in a State of Reſt; which Particle, if it had met with an empty Space much leſs

than it ſelf in the Superficies of the Canal, perhaps by being drove thro' it had avoided that Contact, and ſo could not have repaired that Canal with any Nutrition. Nutrition then conſiſts in reſtoring a Fullneſs of all the Veſſels, which cauſes a Secretion of Part of its own Fluid into the Membrane of every Canal, in the room of the Part diſcharged by the Fibres. From hence it evidently appears, that every Canal in an Animal is nouriſhed by a Fluid, which it often carries within it ſelf. For it is plain a Fluid cannot eaſily break thro' the Sides of its Canal, otherwiſe thoſe Sides could not compoſe a Canal proper for the Conveyance of that Fluid: and that there is no Pore of the Coats of the Veſſel, but what the Parts of the Fluid, which it conveys, can penetrate and work themſelves into, if the Orifice of that Pore, either by a Diſtraction and Motion of the Part, or by Attrition and the Eſcape of ſome Particles from the Contact of the reſt, be but never ſo little widened and encreaſed (for as long as the Orifice is not encreaſed, nothing of the Veſſel is loſt, and ſo there is no occaſion for a Supply by Nutrition.) For they who imagine, that nothing can enter thoſe Pores, but the moſt ſubtle Fluids ſecreted in the Brain or other Places from the Blood, they, I ſay, do not ſeem to underſtand, that thoſe very ſubtle Fluids exiſted ſuch in the Blood before they were received by the ſecreting Veſſels, which are neither furniſhed with a Variety of Ferments, nor Figures.

17. But it is convenient, before we leave this Subject, to remove a Difficulty, which may impoſe upon an unwary Reader. For inſtance, if we may believe the *Poriſts*, we find by Experience that certain Liquors may be injected into certain Veſſels with ſufficient Eaſe, tho' certain Liquors of a greater Subtilty, and abounding with a Force of leſſer Parts, or as yet accounted ſuch, cannot be immitted into the ſame Veſſels with the ſame Eaſe. Since then the Paſſage of a greater Body, where a leſſer is excluded, cannot be aſcribed to a difference of Size, it muſt be to a difference of Figure. But in my opinion, a very different Conſequence is deducible from this: For ſince it is evident by the Light of Reaſon, that in two unequal Bodies, the greateſt Diameter of one of which ſuppoſe equal to the leaſt Diameter of the objected Orifice; but let one of the other, according to the Poſition it approaches the Orifice in, be greater than the Diameter of the Orifice; the firſt Body, whoſe Diameter is equal, can enter and paſs thro' that Orifice, and neceſſarily exclude the ſecond Body, one of whoſe Diameters, which it then applies to the Veſſel, is greater than the Diameter of the Orifice; and therefore becauſe the one Body paſſes, and the Cir-

cumſtances continuing the ſame, the other does not, it evidently follows, that the Liquor conſiſts of Parts, of leſſer Parts, or of Parts abſolutely leſs, than the ſecond, altho' the Parts of the ſecond may be more in number, cloſer united, and heavier, or even more viſible, or have other Properties, by which the common People meaſure the Thickneſs or Magnitude of Liquor. From whence there is a Method laid open of inveſtigating of what Liquors the Parts of their laſt Compoſition are leaſt, that is, have the leaſt Diameters.

18. I take leave to infer from hence, that nothing in the Stomach, nor the Inteſtines, nor in the Lungs, and much leſs in the Heart; in ſhort, that nothing in any Secretion or in Nutrition it ſelf can happen, which is capable of changing the Food into Chymical Spirits, or Volatile Salts, *&c.* For when the Food is comminuted and concocted in the Stomach, the Parts which have the leaſt Coheſion are conſtantly divided firſt, and ſeparated with the greateſt Eaſe. But the Parts, out of which the Veſſels were laſt compounded, or by whoſe Acceſſion they were encreaſed, cohere leſs, than the Parts of thoſe Parts, ſince they were divided and ſecreted from the reſt, by the Force of the Heart and the Blood, but the other were not. But after they were thus ſeparated in the Stomach, ſo as to flow with Eaſe one o-

ver the other, then they are expell'd by the Motion of the Stomach into the *Lacteals.* From whence it follows, that there is nothing tranſacted in the Stomach, from whence one may certainly conclude that Salts, Sulphur, or other Bodies, that paſs for *Principles*, can be extracted from the Concoction of the Food: Nor are they to be heard with Patience, who in treating of Phyſic, make uſe of ſo precarious a Philoſophy, who are not aſhamed to aſſert, that there is a Diſſolution of a *Nutritive Sulphur* made in the Stomach, and that *Chylification* is the Action of an *inviſible* Spirit, that ſeparates and changes the Aliment (by the Help of a Heat and Ferment) into a *Nutritive Oleo-aquoſe Sulphur*; and that an *Analyſis* of *Alcali* and *Acid*, is made in the Stomach, to relax the Union of the Sulphur: For that Sulphur is a ſort Reconciler of *Salts*, otherwiſe oppoſite to it ſelf, as *Wolſangus Wedelius*, an Author of great Gravity, endeavours to perſwade his Reader in the 9*th* Chapter of his *Phyſiologia Reformata*.

We muſt enter into another Courſe or Method of Reaſoning, if we would advance the Theory of Phyſic, to the Dignity of the Subject, and aſſert an Art, glorious in it ſelf, and neceſſary to Mankind, from mean Conjectures, and the Scandal of Uncertainty. And an Inſtance of ſuch a Method we have here given, in a Caſe of no great Difficulty indeed, but ſo much the more probable to be of greater Service for the future, as the Inconſiderableneſs of the Difficulty will leſs divert the Reader from a diſtinct View of the Method. Becauſe, it is manifeſt, that nothing more is requiſite to give a Phyſical Solution of this Queſtion, but to find ſuch Solids to be ingeſted, as can moſt eaſily repair the Loſs of the Parts, that fly off from the Coats of the Veſſels, and the Stock of the Fluids: and to fix upon the moſt ſimple Powers of the Stomach, or Powers to be applied in it, as are capable of reducing the ingeſted Solids to ſuch Fluids, out of the Parts of which thoſe ingeſted Solids were laſt made up and compounded. But it is plain, that the Parts of Vegitables, or of Animals of all Claſſes, anſwer to the firſt *Quæſitum*, and that the Motion of the Stomach, and *Abdomen*, and the adjacent Muſcles, without a vain Enquiry after any other Aſſiſtance, ſufficiently anſwer the ſecond Requiſite. But what is moſt neceſſary to obſerve here, is, that in the Solution of this, there was no Occaſion for a Philoſophical Knowledge of the Nature of Foods, or the Magnitude, or the Figure of Parts or Pores of them, or of the Motion of Fluids paſſing thro' thoſe Pores; nor was it uſeful in this Enquiry to have known, whether there were any paſſing Fluid at all, or whether all the Parts of the Food were of the ſame, or a different Figure. But it is ſufficient, if we know that a Solid which grew into that Subſtance by a Conjunction of Bodies, before in a State of Fluidity, can be reduced into a ſimilar Fluid, if thoſe Parts are divided, and drove different ways; and again, that there is a *Conatus* in the Stomach, by which the Parts of Solids may be ſo divided, and then that the Fluid being reſtored to its primitive Nature, or to it ſelf, will paſs into the Subſtance of Veſſels, in the ſame manner, as it did before into ſimilar Veſſels. And this is ſelf-evident, that ſuch Alterations are agreeable to Bodies enjoyning any Figure or Motion, and that this does not require any Knowledge of the intimate Eſſence of Things, or a penetrating Inſpection into the ſubtle and Phyſical Cauſes of Philoſophy. What I have advanced, ſeems to me a Proof, that the Food cannot be concocted without the Aſſiſtance of the Stomach, and the grinding Muſcles of the *Abdomen*. It remains for me to prove, that the Powers of the *Diaphragm*, and the Muſcles of the *Abdomen*, are of a Force ſufficient to diſcharge the Office and Weight our *Hypotheſis* lays upon them. Now theſe Powers, whether we inveſtigate them by the Help of the 121 Propoſition of *Borellius*'s Works, or a Principle of Sir *Iſaac Newton*'s, deducible from thence, will appear to be very extraordinary. Whoever calculates this Matter rightly, will find that the Powers of the Muſcles are in a *Ratio* compounded of the *Ratio* of the Longitudes, Latitudes, and Profundities, that is, in a *Ratio* of homogeneous Solids, or Weights. But the *mean* Weight of the Muſcle that bends the Third Joint of the Man's Thumb, is equal to 122 Grains; that of the right Muſcles of the *Abdomen*, to 3720; that of the *Pyramidals*, to 126; of the *Oblique Aſcending*, to 2640; of the *Tranverſe*, 2640; of the *Oblique Deſcending*, to 2040; the Weight of the Diaphragm is equal to 3960 Grains. Wherefore the Sum of the Weights of the Muſcles of the *Abdomen* adapted to this Office is equal to 15126 Grains.

Now according to the 126*th* Propoſition of *Borellius*'s firſt Book of the Motion of Animals, the Power of the *Flexor* of the Thumb is equal to 3120 Pounds-weight; and therefore as 122 Grains are to 3720 Pound, ſo 15126 Grains are to 461219 Pound. From hence it is plain, that the Powers of theſe Muſcles are not inferiour to the Powers of any Mill-ſtone: And he *who knows that the Author of Nature never attempts any thing in vain, nor performs one Thing by many Means, but many things by a ſingle one*, will eaſily acknowledge that the Muſcular Action of the Stomach, and the united Actions of the Muſcles compreſſing the Stomach, are thoſe Forces, which reduce the Food ingeſted into the Stomach into a Fluid, adapted for the

Nutriment of the Animal, and the Supply of the Decays of the Blood. But altho' we had not made uſe of the Powers of the Muſcles of the *Abdomen* in this Caſe, yet the Powers of the Stomach it ſelf are ſufficient to perform this Duty as ſucceſsfully as we could wiſh. The mean Weight of a human Stomach is 8 Ounces, and therefore by making a Calculation after the manner of the preceeding, the Power of the Muſcle of the Stomach will be found equal to the Weight, 12951 Pound, which is quadruple the natural Power of the Heart, by the *67th* Propoſition of the ſecond Part of *Borellius* upon the Motion of Animals, which proves that the latter is about 3000.

* * *

A
SOLUTION
OF THE
PROBLEM
Concerning
INVENTORS.

I HAVE long ſince made it my Obſervation, that nothing was more deſtructive to any State, than the Credulity of the People, and what naturally follows that, a perpetual Deſire of Innovation. For as often as Men of Deſign and Cunning have begun to ſlide into their Hearts and good Opinion to that Degree, as to gain an implicite Confidence from the People, we may obſerve that the Cuſtoms of that State have been ſubverted, the Laws and Acts of their Anceſtors repealed, all Rights, both Human and Divine violated, as ſtanding in the way, and obſtructing the Deſire of Innovation, and the Meaſures of the Deceivers of the Populace.

But I don't at all wonder, that the Artifices of the Cunning ſhould gain more upon the unthinking Multitude, than the Reaſons of the Wiſe and Learned; I rather wonder that ſome of the firſt Genius's and Divine Spirits ſhould often follow the Example of the People, and be ſeduced by the Authority of thoſe, whom they exceed in all Kinds of honourable Arts, and all Degrees of Vertue.

Wherefore it ſeems to me, that I ſhall acquit my ſelf well, if I can ſhew thoſe who are willing to cultivate Truth and Honour, a way to vindicate themſelves from ſo baſe a Slavery, and remove that Cloud from their Minds, which the Authority of a few Men has ſpread before the Face of Truth: for to endeavour to bring the Vulgar to the Right, were an Undertaking of a Mad-man. But in order to do ſome Service to thoſe of better Skill, and who are enflamed with a Deſire of attaining higher Arts; I ſhall ſhew in this Oration, in what Caſes, and the Authority of what Perſons ought to move us, or what ſort of Men deſerve our Credit, and as Relaters of what Facts, and at the ſame time ſolve, what was never before attempted, ed, the noble Problem of *Inventors*. In the Purſuit of this, I ſhall uſe the Terms of Author, Inventor, Obſerver, and Hiſtorian, for one and the ſame Idea; and I would have it obſerved, that there are two Caſes in this Problem: for either the Authority of the Inventor enters into the Conditions of the Problem, or it does not. The following Paragraphs will ſolve the firſt Caſe.

2. We ought to make a nice Diſtinction between thoſe things which are demonſtrated by their own Evidence, and thoſe that are ſo by the Light of other things, that is between ſuch things whoſe Evidence is ſuch, that when we have once underſtood their Proofs, we cannot conceive them to be otherwiſe; and thoſe things which are neither demonſtrated from themſelves, nor other things. Of the firſt kind is this, *The Whole is greater than the Part*; of the ſecond, This, *Pythagoras found out* the 47*th Propoſition of the firſt Book of* Euclid. By Things demonſtrated, I underſtand then ſuch things, whoſe Proofs make it impoſſible, that they ſhould be otherwiſe than they are; from whence it follows, that they are always the ſame, and unalterable; but by things not demonſtrated, I mean ſuch, whoſe Proofs do not make it impoſſible, but that they may be otherwiſe; from whence it cannot be concluded, that they are always the ſame. Arguments ſuited to the firſt kind, are called

led *Demonſtrations*, to the latter, Probabilities. Hence it appears, that no finite Number of Probabilities is equivalent to a Demonſtration; and again, that we are by no means ſo certain in giving our Aſſent to Things not demonſtrated, as when we give it to Things demonſtrated; and therefore we ought to adhere ſo poſitively to an Opinion unſupported by Demonſtration, as to another that has that on its ſide.

3. We muſt further obſerve, that they who will allow the Credit of a Writer's or Author's Obſervations, that is, they who propoſe an Inventor, whoſe Authority enters into the Conditions of the Queſtion, neceſſarily aſſume theſe Propoſitions for Truth.

I. That we always believe the Evidence of our Senſes; which wants no Proof.

II. That the Inventors of the Obſervation propos'd, always told the ſame to others, which they had found by the Aſſiſtance of their Senſes; which is not a Demonſtration.

III. That thoſe Perſons, thro' whoſe Hands the Obſervation comes deliver'd down to us, have in all Ages been ſo honeſt, as not to deliver any thing to Poſterity, different from what they receiv'd from their Predeceſſors; which is not demonſtrated.

IV. If an antient Obſervation is deliver'd without being put in Writing, then we muſt aſſume this Propoſition for a Truth, that thoſe Perſons, thro' whoſe Hands it is deliver'd to us, never have forgot the whole or any part of that Obſervation, which is far from being a Demonſtration.

From whence it follows, 1*ſt*. That we are more certain of Things demonſtrated, than of any Fact taken from the Credit of Hiſtory, containing ſuch Obſervations. And, 2*dly*, That we are more certain of Things, the Knowledge of which we receive by our Senſes, than thoſe we know from the Help of ſuch Hiſtories, and therefore that an Argument drawn from the Credit of ſuch Hiſtories, is not of Force againſt Demonſtration, or the Evidence of Senſe.

4. Beſide it follows from hence, that we are not ſo certain of the Truth of an Obſervation, as the Authors of it were: for they only uſe the firſt Propoſition as a thing certain, and demonſtrated; we by truſting to them, aſſume that and the ſecond too as a Demonſtration: and after the ſame manner that we are not ſo certain of the Truth of an old Obſervation, or one that being formerly tranſacted, cannot be made again, as of a new one, or one which may be made at the Pleaſure of the Obſerver; becauſe in aſſenting

ing to a new Relation of Fact, we only take for ganted the firſt and ſecond Propoſition; but in an old one, we aſſume not only them as Truth, but the third Propoſition too. In the laſt Place, we are not ſo certain of the Truth of an unwritten Hiſtory of Facts, as of the Truth of a written one, becauſe in the giving Aſſent to the Credit of the written, we only allow the three firſt Propoſitions as demonſtrated; but when we credit an unwritten one, we muſt make uſe of the fourth Propoſition too as demonſtrated, tho' it is not ſo: and by Conſequence we embrace more Things as demonſtrated, which are not ſo in one Caſe, than we do in the other; that is, more Things which have the greateſt Marks of Uncertainty.

5. It is eaſy to perceive from hence, that no Sayings of any Inventor, whoſe Authority enters into the Conditions of the Queſtion, ſuch as *Ariſtotle* with the Peripatetics, and *Hippocrates* with ſome Phyſicians, and others with others, ought to be ſo interpreted, as to contradict any Demonſtration, or Evidence of Senſe, or even any Opinion, which is equal to an Evidence founded upon Ideas ſupplied by the Senſes: or to contradict any Propoſition, tho' undemonſtrated, upon which all Hiſtorical Credit depends; or laſtly, any Opinion, which is ſupported by Foundations not leſs probable, than theſe Axioms are upon which the Au-

thority of Hiſtory depends. And we ought always to remember, that the Liberty to be exerciſed in interpreting of Hiſtory, is ſo much the leſſer, as the Authority of the Inventor or Hiſtorian is greater, or the fewer the Number of Things undemonſtrated is, upon which, as taken for demonſtrated, the Hiſtory is founded.

6. But let us proceed to the ſecond State of the Problem, that is, when the Authority of the Inventor does not enter into the Conditions of the Queſtion. The Difficulty of which is ſolvable by the following Theorems.

THEOREM *the Firſt.*

He ought to be accounted the public Author of any Invention, who firſt laid down ſuch Principles, from which that Invention is more eaſily deducible, than any Propoſition of Euclid'*s from his Axioms, Definitions and Poſtulations: And who in laying down theſe Principles, did not buſy himſelf in drawing in ſuch Corollaries, as are of infinitely leſs Moment, and Uſe, than the Thing it ſelf, which is the Subject of Enquiry. But if he neither laid down ſuch Principles, from whence the Invention is deducible with that Eaſe, nor did explain the Invention it ſelf in expreſs Terms, but advanced many other Things of leſs Moment, expreſly and prolixly, as flowing from his*

his Data: *He is not to be accounted the public Author of the Invention, which is the Subject of Enquiry.*

This Propoſition is demonſtrated from this, that no Philoſopher or Phyſician know every thing which is deducible from Things here.

THEOREM *the Second.*

Whoever firſt publickly mentioned the Invention in the Queſtion, and ſpoke of it after the ſame manner, as it was afterwards ſpoke of by others, whom all Perſons allow to have known that Invention, nor did at the ſame time, and equally or more expreſly inſiſt on other Things, which contradict that Invention; he ought to be accounted the public Author of it. But if he mention'd no otherwiſe, than it was mention'd by others, whom all Perſons allow to have been ignorant of that Invention, and laid down other Things more frequently and more expreſly, that contradict that Invention, he ought not to be accounted Author of that Invention.

This Propoſition depends upon this Aſſumption, that if any Author has left it in writing in ten Places, that the Number of the Stars is odd, and but in one Place, and ſpeaking of the ſame thing, that they are even, it is credible that it was his Opinion they were odd. Wherefore if any

Phyſician ſpeaks very obſcurely of the Circulation, and very often has expreſly laid down Things not only oppoſite to ſome Effects of the Circulation; that is, to Corollaries dependant on it, but plainly repugnant to the Circulation it ſelf; that is, contradictory to all the Propoſitions, upon which the Principles of Phyſic are built; it is not to be ſuppoſed that he knew the Circulation of the Blood.

7. But to ſet this Matter in the cleareſt Light, we are to underſtand, that ſomething is then ſaid to enter into the Conditions of the Queſtions, when the Change of that makes a Change in the Queſtion. And therefore that is not ſaid to enter into them, which if changed, or in another State, the Problem is not alter'd. To apply this then to the firſt Caſe, in which the Authority of the Inventor may be aſſumed to be very conſiderable, it is evident that there is nothing falſe to be found in the Writings of ſuch an Hiſtorian: but becauſe we own our Belief from the Teſtimony of many Perſons, that theſe are the Writings of that Hiſtorian, therefore we aſſume at the ſame time all the Propoſitions laid down in the third Paragraph as certain; from whence it manifeſtly follows, that there is nothing contain'd in the Writings of that Hiſtorian, that contradicts the Senſe, or its Evidences, or other Things equally certain; and if any thing

of that Nature is found in any of his Writings, that that is not the Writing of ſuch an Hiſtorian, from whence the Truth of the 4*th* and 5*th* Paragraphs appear.

8. Farther, if the Authority of the Inventor does not enter into the Conditions of the Problems, then it may be look'd upon as nothing; for it contributes nothing toward the Solution of the Queſtion, and therefore ought to be accounted as nothing. But when the Authority of the Inventor is meaſur'd by his Veracity, or his conſtant Inclination and Skill in ſpeaking thoſe Things which depend upon that Skill, it is plain in the ſecond Caſe of this Queſtion, that even his Skill and Inclination, to ſpeak agreeable to that Skill, are accounted as nothing; that is, they are not at all to be conſider'd. From whence it follows, that the Words of an Hiſtorian or Inventor, may, and often ought in this Caſe, to be ſo interpreted, as to be contradictory to the Evidence of Senſe, apparently falſe, and repugnant to Demonſtration; as after the ſame manner ſometimes Men ought to be explain'd, as of no Authority in what they ſay, who themſelves will own that they and their Company often ſpeak of Things apparently falſe, and abſurd, and interpret one another's Diſcourſe in that Senſe.

From whence I conclude, when it is enquir'd, whether *Hippocrates* knew the Circulation of the Blood (in which Queſtion the Authority of *Hippocrates* is reckon'd as nothing, or of no advantage, ſince no one will affirm that he knew the Circulation, becauſe he was a Man of great Knowledge) that we may interpret his Words with the ſame Liberty as thoſe of an ignorant Perſon, ſo as to make them falſe and abſurd, nor ought his Authority to be appealed to in this Queſtion, as having aſſerted Abſurdities and Contradictions to the Circulation of the Blood, nor his Words to be ſoftened with a more favourable Conſtruction. I infer from hence too, that in the ſecond Caſe, *viz.* when the Authority of the Inventor does not enter into the Conditions of the Queſtion, the two Propoſitions in the ſixth Paragraph are neceſſarily true: For ſince in that caſe his Authority is nothing, an Inventer either in Philoſophy or Phyſic ought not to be ſuppoſed of ſuch a Genius, as to have underſtood more than he has delivered in expreſs Words; from whence the firſt Theorem is deduced: Nor of ſuch Knowledge, as that he could not lay down falſe and abſurd Propoſitions, and often did, from whence the ſecond Theorem is derived.

For the more eaſy Comprehenſion of what has been advanced, I would have it remark'd in what manner it may be applied to the Solution of the Queſtion of the Inventer of the Circulation of the Blood. The Queſtion turns upon this, to diſcover whether *Hippocrates* knew the Circulation of the Blood. But it ought to be made evident, that the Term *Circulation* was uſed by *Hippocrates* in the ſame Senſe, as it has been by many of much a later Date, ſo as to diſcover a clear and diſtinct Deſcription of the Circulation in *Hippocrates*.

But I affirm, that the Circulation is never expreſly deſcribed by *Hippocrates*, and that there is no Paſſage in his Writings, which can incline one to believe, that that Motion was underſtood by him, but only that there was a Poſſibility that it might be ſo; for tho' he no where mentions a continual Circulation of the Blood, yet he often mentions ſuch things, from whence the Circulation may be deduced, which however he never does deduce from thence, altho' it is an Invention of a much greater conſequence, than all thoſe things which he has inferred and tediouſly inculcated from Principles which he did know. For inſtance, Veneſection was known by *Hippocrates*; the perpetual Circulation of the Blood is deducible from that Operation: Yet he does not diſcover this Circulation from thence, but runs on with a nauſeous Loquacity in advancing abundance of other Matters, ſome of which are mere Trifles, ſome abſurd and deſtructive of the Circulation, and all of them of no conſequence at all. Let they who are too great Admirers of him, read his Books, *Of the Parts in Man*, *Of the Morbus ſacer*, *Of the Regimen of Diet*, and then they will plainly ſee how much he extols himſelf, when he relates Inventions of his own, which are in the leaſt degree comparable to that of the perpetual Circulation of the Blood. Indeed it is not to be believed, but that *Hippocrates*, a Native of *Greece*, and one who ſo often treats his Reader with trite Subjects, would have proſecuted the Circulation in a pompous oratorical manner, if he had known it; ſince that for its Uſefulneſs and Glory far exceeds all the Inventions of *Hippocrates*, and all the Deſcendants from *Æſculapius*. *Hippocrates* knew the Pulſation of the Arteries, and he ought to have collected the perpetual Circulation of the Blood from thence, but he collects no ſuch thing: But when he was to deſcribe the Cauſe of the Pulſe, he laid down a Propoſition contradictory to the Circulation; which he had not done, if he had at all underſtood the true Cauſe of the Pulſe, *viz.* the Circulation of the Blood. And what Cauſe do you imagine that *Divine Old Man* dreamt to be the Reaſon of the perpetual Pulſation between the Ears and the Temples? I do not ſpeak of the Increaſe of the Pulſe upon Fevers, and the Pain of the Head, which is not perpetual, and which *Hippocrates* has treated of in his Book *of Vapours*: for he gives us the Cauſe of a perpetual Pulſation in his Book *Of the Parts in Man*, which is this: There is Blood contained in all the Veins of the Body, excepting in the Veins which have a continual Pulſe between the Ears and Temples; for there is no Blood in them: becauſe the Blood which is neareſt to them, endeavours to retreat from them, and being turned into a contrary Channel, meets the oppoſite Blood, with which it contends, and from that Contention ariſes the Pulſe.

Let it be obſerved in the next place, that *Hippocrates* never ſpoke otherwiſe concerning the Motion of the Blood, than others have ſince ſpoke, who it is plain did not acknowledge the perpetual Circulation, and ſome of whom even denied it, after it had been proved and demonſtrated by Dr. *Harvey*. Let any one who is pleaſed to take that Pains, read over the Phyſicians of a longer Date than Dr. *Harvey*, and ſome of his Contemporaries, and he will certainly find the Truth of my Aſſertion; for I am not at leiſure to recite their Opinions. Since theſe things are ſo, we may conclude that the true Circulation of the Blood was unknown to *Hippocrates*.

Hippocrates knew the Structure of the Heart, and its Motion, and writ a Treatiſe upon that Subject, and *Harvey* and other Moderns have writ upon the ſame, and I wiſh thoſe who aſſert that the former knew the Circulation, would read attentively their Writings upon the Heart. In *Hippocrates*'s Book *Of the Heart*, there is not a Word of the perpetual Circulation, but many directly oppoſite to that Motion of the Blood. For after he has declaimed in his manner, in abundance of Words, upon the Liquor of the *Pericardium*, of the Reaſon why the Water falling down upon the *Larynx* ſhould provoke a Cough, he takes a deal of Pains to prove that the Auricles of the Heart are not the Organs of Hearing, becauſe, ſays he, they have not the Bores of the Ears, nor can hear the greateſt Noiſe. *Hippocrates* was certainly profuſe enough of Words; and therefore it is not to be imagined, but that he who deſcended to the Explication of ſo many inſignificant Trifles in abundance of Words, would have ſpoke of the Circulation of the Blood according to the Dignity of the Subject, but that he did not underſtand it. But farther, when he had the faireſt Occaſion of giving a full and elegant Deſcription of this Circulation, he only informs us, that the Mind of Man is placed in the Left Ventricle of the Heart; but he every where affirms, that the Blood is put into Motion by the Soul, and drove thro' what we term the Veins toward the extreme Parts of the Body, and that it is forced back again thro' the ſame by the uncertain Motion of the ſame Soul; and when that ceaſes to act, the Blood is at reſt. For

I think this a proper Remark, that *Hippocrates* often gives a prolix Account of things, which are ſo manifeſtly contrary to the Circulation of the Blood, that he muſt neceſſarily be ignorant of it, when he wrote thoſe things. It is indeed poſſible, that one of a moderate Skill in the Elements of Geometry may advance a Propoſition deduced by a tedious Train of Conſequences, which may perhaps be found repugnant to ſome Principles of that Science; but it is impoſſible that one who underſtands thoſe Elements ſhould often advance ſuch things, as are plainly oppoſite to all the Propoſitions of that Science. Wherefore ſince *Hippocrates* has frequently and in expreſs Words delivered Things not only obſcurely contrary to the Circulation of the Blood, or to ſome Corollaries dependant upon it, but apparently repugnant to it, that is, things evidently contradictory to all the Propoſitions of Phyſic, it is not to be imagined that he underſtood the Circulation of the Blood. I deſire thoſe who read *Hippocrates* ſo curiouſly, to find ſomething which ſeems to ſhew the Circulation of the Blood, to extract and remark upon thoſe Paſſages, which diſcover the direct contrary: For they will find a prodigious Number of thoſe; and I do aſſure them, that this would be a Task of much leſs difficulty than that which they are upon, and yet would not prove of leſs advantage.

9. We muſt therefore add to what has been ſaid, that it is not ſimply enquired in this Place, whether *Hippocrates* knew the true Circulation of the Blood, but whether that Motion of the Blood is ſo confirmed and deſcribed by him, that others by the Inducement of his Reaſoning, and not merely by his Authority (which ought to have no place among Phyſicians) could and ought eaſily to have allowed the true Circulation, or farther that they did, or profeſſed that they allowed it. Becauſe the Queſtion is, whether *Hippocrates* was the Author of the Doctrine of the Circulation, that is, whether he inclined others to believe the Truth of it. It is known, that the Geometricians, who have demonſtrated any Theorem not expreſly demonſtrated by *Euclid*, or any other Geometrician, altho' it naturally flows from Theorems demonſtrated by others, are accounted the Authors of that Theorem; and that they acquire the greater Reputation, the eaſier the Method appears, which they made uſe of in deducing their Theorem from others before known and demonſtrated. And it is well known too, that the Geometricians never enquire, whether ſuch a Theorem was known to another, or accounted as true (for that does not promote Geometry, and I may ſay Phyſic, where the Caſe turns upon Reaſon and Demonſtration, not upon Authority) but they enquire, whether it was therefore

demonſtrated by Another. There is no one who will allow a Geometrician to be the Author of a Theorem, which he has not demonſtrated, or will think himſelf the leſs obliged to him who did firſt demonſtrate it, becauſe another Perſon took upon Truſt, or founded upon Conjecture, a Truth which was Geometrically demonſtrable. In the ſame manner, the Learned ought not to enquire with too great a Concern, whether *Hippocrates* has not aſſerted ſome things, which we who have drawn our Knowledge of the Circulation from others, may think lead that way, altho' even that is falſe; but whether *Hippocrates* ever brought any one Proof of that Principle, by which others will own that they were induced to give Credit to the Circulation, which they were before ignorant of; but there never was any one who would profeſs that. For as for what ſome aſſert now-adays, after the whole Subject has been demonſtrated, that *Hippocrates* has clearly laid down the Structure and Uſe of the Valves of the Heart, that is nothing to the purpoſe: For how many have there been, who have explain'd their Structure and Uſe better than *Hippocrates?* Even all the Anatomiſts and Phyſicians ſince the Time of *Hippocrates*; who however were ſo ignorant of the true Circulation of the Blood, that ſome of them who knew *Columbus*, *Cæſalpinus*, *Servetus*, and others, and had read their Books, yet writ againſt that Doctrine of theirs. I conclude in the laſt place, that *Hippocrates* did not know the true Uſe of the Valves of the Heart. This is evident from his Book *upon the Heart*, wherein the following Paſſage of the Right Ventricle and its Veſſel appears. *It opens indeed into the Lungs, to give a Paſſage to the Blood thither for their Support; but it cloſes toward the Heart, tho' not very ſtrictly, for to allow an Entrance to the Air, tho' not in a great Quantity.* From whence it is plain, that *Hippocrates*'s Uſe of the Valves was, that ſo much Blood which was not to return might paſs out of them, as was ſufficient for the Nutriment of the Lungs; while the Air entred thro' the ſame Paſſages out of the Lungs; all which is entirely foreign and repugnant to the true Circulation of the Blood, and the true Account of Reſpiration.

10. It is not now worth our while to remark upon all thoſe Paſſages, which ſhew that *Hippocrates* entertained a Notion directly contrary to the Circulation of the Blood, as explained by the Moderns: Give me leave to ſelect a few Places out of abundance that might be mentioned. *Hippocrates*, in explaining the Cauſes of Madneſs after his manner, in his Book *De Morbo Sacro*, has theſe Words towards the Concluſion.

Now if the attendant Symptoms of this Diſtemper are Fears and Apprehenſions of Evil, *then it ariſes from an Alteration in the Brain, which happens upon the Encreaſe of Heat in the Brain from the Bile, where it is carried with a great force from the Body into the Brain, thro' the Veins which convey the Blood. But theſe Fears continue, till it returns again into the Veins and Body, and then they vaniſh. But the Patient feels a ſudden Anxiety and Dejection, as the Brain grows cool, and is compreſſed extraordinarily. But that happens from the Phlegm, and that Affection cauſes a Forgetfulneſs in the Patient. But when the Brain grows warm on a ſudden, he cries out and makes a Noiſe in the Night, and that Symptom happens to the Bilious, and not to the Phlegmatic, ſince they do not grow warm upon a copious Effuſion of the Blood into the Brain, and its fermenting there. But the Blood is conveyed often through the aforeſaid Veins, when it happens that the Patient ſees a terrible Diviſion, and is in as certain Fears as if he were awake; then his Face glows with Redneſs, and his Eyes grow red, and he deſigns ſome Miſchief in his Mind; and ſo it happens too in his Sleep. But when he awakes, and comes to his perfect Senſes, and the Blood is again diſperſed in the aforeſaid Veins, then the Symptoms ceaſe.*

From which Paſſage I think it is evident, that *Hippocrates* thought that the Blood return'd from the Brain thro' the ſame Veins by which it was conveyed thither, and that it fluctuated in the ſame Veſſels backwards and forwards; which Motion he believing to be perform'd at a ſtated Diſtance of Time in the ſame Perſon, called thoſe oxillatory Motions, Periods.

11. And from hence it is manifeſt, how weak that Argument is in Favour of *Hippocrates*, which is drawn of his Book of *Dreams*, where this Paſſage occurs. *Rivers in an unuſual State denote the Period of the Blood; their extraordinary Flows its Exuberance, and their Decreaſe its Defect; but we ſhould encreaſe the latter, and diminiſh the former by a Courſe of Diet.*

There never was any Phyſician, who, tho' an Adverſary to the true Circulation, did not attribute ſome Motion to the Blood, but always thro' the ſame Veſſels, after the Manner of the *Euripus*; wherefore they may, and uſually do, affirm the ſame as *Hippocrates* here does. For his Words allow a Motion to the Blood; but not a circular one, ſince Rivers do not return in a Circle to their Fountains, as it is now determined that the Blood does thro' continual contiguous Canals: And it is Matter of Admiration, that ſo many learned Men obſerving that *Hippocrates* every where aſcribed a Period to the Motion of the Blood, ſhould believe that *Hippocrates* knew and expreſſed by that Word the true Circulation of the Blood; whereas that Word in his Meaning ſignifies only (as it often does among the Philoſophers and Geometricians) a Fluctuation in the ſame Veſſels, at ſtated Times (as the Place here makes it evident) now into theſe Parts, and then into contrary ones, which Fluctuation is ſometimes performed with a greater Quantity of Blood, and quicker, and at others with a leſs, and more ſlowly. But this will appear from another Paſſage of his Writings.

12. Now a little beyond the Middle of his Book upon the *Food* he ſpeaks thus: *The Root of the Veins is the Liver, the Root of the Arteries is the Heart: The Blood and Spirits move and are diſperſed from theſe over the whole, and the Heat is diſperſed with them.* Which Place, if we compare it with that of his Book *upon the Heart*, where ſpeaking of the Ventricles of the Heart he ſays, *Theſe are the Fountains of human Nature, from hence run the Streams by which the whole Channel of the Body is irrigated*; which makes it plain, that *Hippocrates* believ'd the Motion of a Fluid toward the extreme Parts of the Body, returning thro' the ſame Veſſels, to be perform'd in the ſame manner from the Liver as from the Heart. That this was *Hippocrates*'s Meaning, is evident from his Book *of the Places in Men*, where not far from the Beginning he has theſe Words.

There are two Veins which lie near the Temples, between the Temples and the Ears, which reach

reach to the Eyes, *and have a continual Pulſe. For theſe only*, *of all the Veins*, *have the leaſt Moiſture*, *the Blood being turned away from'em: But the averted Blood has a contrary Motion to that which flows in*, *and that which is averted has a Tendency to retire*; *but that which flows in from the Parts above having a Tendency to proceed lower*, *they meet here*, *and working upon each other in a Circle*, *produce a Pulſe in the Veins.* By which Words he means no more than that the Pulſe is produced by the Motion of the Blood thro' the ſame Canal, from each Extremity of the Canal. And this is the Reaſon of the *Hippocratical Circulation* of the Blood in a Perſon in a State of Health; for in Fevers he aſſigns another Cauſe equally abſurd, and repugnant to the true Circulation, in his Book of *Vapours*, where he makes the Air and the Blood paſs thro' the ſame Veſſel into contrary Parts: Which abundantly proves, that he who has not produced his Belief of the true Circulation in any Place of his Writings, nor produced one Argument for it, was intirely ignorant of the Manner of that Motion.

13. Altho' I am weary of writing ſo much on this Subject, yet I ought not to omit Anſwering a certain eminent Writer, who produces theſe Words from *Hippocrates*'s Book of the Regimen of Diet in Acute Diſtempers. *A Quinſie happens*, *when a large and glutinous Defluxion*, *either in the Winter or Summer*,

mer, falls into the Jugular Veins, and thoſe Veins have attracted a more copious Flow of Matter by an Increaſe of the Amplitude of their Veſſels. Firſt, all this is falſe, and repugnant to the true Circulation. Again, he himſelf very juſtly owns, that the Arteries may be as well meant in this Place as thoſe which we call the Veins. But we allow that they are what we call now the Jugular Veins, it only follows from hence, that the Blood moves in its Veſſels ſometimes faſter, and at others more ſlowly: But there is not a Word here of its true and circular Motion. But that Learned Perſon in part of his Writings prejudges the Queſtion in theſe Words. *If you will allow me that the Blood moves, I will eaſily prove that it circulates too.* But the Queſtion is not whether the Blood circulates, but whether *Hippocrates* knew that it did; nor ought we to infer, that becauſe it might have been found and diſcovered by what *Hippocrates* did know, that therefore it was diſcover'd by *Hippocrates*; ſince every *Barber* knew the Neceſſity of a Ligature in *Veneſection*, which however did not give an Opportunity to the moſt acute Phyſicians, but within a few Ages, of diſcovering the Circulation, tho' it might have been diſcover'd more eaſily from thence than any thing beſides, and much more eaſie than from the Words of *Hippocrates*, even thoſe which are ſuppoſed to contain it in the plaineſt Terms.

14. But we muſt examine a Paſſage of *Hippocrates* in his Book *De Morbo Sacro*, where he has theſe Words: *A great Number of Veins, and thoſe very minute, proceed from all Parts of the Body to the Brain; but there are two large ones, one riſing from the Liver, the other from the Spleen. Now that which is derived from the Liver runs in this Manner; one Part of the Vein is carried to the Right Hand, near the Kidney and the Loins, and downwards to the internal Part of the Thigh, and reaches to the Foot, and is called the* Vena Cava. *But the other Part ſtretches thro' the Veins on the Right, and the Lungs upwards, and is divided into the Heart and the Arm. But its other Part ſtretches thro' the Throat, on the right ſide of the Neck upwards into the Skin it ſelf, where it is conſpicuous to the Eye; but it is concealed near the Ear, and there it divides, and its largeſt, thickeſt, and wideſt Part, ends in the Brain: But in the other Part, where the Vein is leſs, Part is carried to the right Ear, Part to the Eye, and Part to the Noſe: And this is the Courſe of the Vein from the Liver. But the Vein from the Spleen runs to the left upwards and downwards, as that from the Liver, but leſſer and weaker. Now we draw in a great Quantity of Air thro' theſe Veins: For theſe are the Vents of the Body, as drawing the Air to them, and deriving it to the reſt of the Body, and cooling it in the Veins, and then emitting it again.*

From whence it is plain, that what we call the Veins now attracted and emitted the Air in *Hippocrates*'s Opinion; that is, emitted thro' the ſame Vents by which they attracted it. From whence it follows, that he who did not uſe an expreſs Demonſtration to inculcate the Belief of the Circulation of the Blood, ought to be eſteemed ignorant of it, if he produced ſuch Principles as we have heard *Hippocrates* advance; they being evidently to the Circulation as we at preſent underſtand it.

Theſe Words follow ſoon after in the ſame Book, which deſerve our Notice. *Now the Defluxion is greater toward the Right than the Left, becauſe the Veins are larger, and more in Number there than on the Left, as ſtretching from the Liver and the Spleen.* From whence it is plain, that *Hippocrates* believed and delivered it as his Doctrine, that the Blood and Phlegm (which he makes to flow into all Parts) flowed thro' the Veins from the Liver and Spleen into all Parts of the Body, which is entirely contrary to our Circulation, and ſhews that he was ignorant of it.

15. But it appears more clearly what was *Hippocrates*'s Opinion in this Point from his 4th Book *Of Diſeaſes*. At the Beginning of that Book he ſays, *The Stomach, when full, is the Fountain of all Juices in the Body, but when empty it drains from the decaying Body.*

But there are four other Fountains, each of which empties into the Body, (that is, the Bile, the Blood, the Water, and the Phlegm, of which he was then ſpeaking.) *After then theſe Fountains have received their Proportions from the Stomach, and they are again emptied, they drain from the Body. It is certain the Heart is the Fountain of the Blood, the Head of the Phlegm, the Spleen of the Water, and the Scituation of the Bile is in the Liver.* Again, he farther adds in the ſame Book, *But thoſe Parts which I have termed Fountains, when they are full, always tranſmit into the Body; but when they are empty, they are encompaſſed and drain'd by that on all ſides: And the Caſe is the ſame with the Stomach; For the Caſe is reſembled by this Inſtance; If any one pours Water into three or more Veſſels, and places them on a plane Surface, and at the ſame time diſpoſes it ſo that there is a Communication between them by Pipes; and then pours the Water gradually into one of the Veſſels till they are all filled; for the Water will flow from one Veſſel to the reſt till the reſt are filled. But when the Veſſels are full, if any one draws the Water out of one, the Water will in its turn flow back (*you ſee that it will flow back thro' the ſame Pipe that conveyed it) *into the Veſſel,* (that is, into the Veſſel from whence the Water is drawn;) *and the Water will be refunded from the Veſſels in the ſame Manner as they received it. Thus,* *without Queſtion, the Caſe is in the Body.*

And now I think it is plain enough, that *Hippocrates* knew nothing of the true Circulation, ſince we may be abundantly convinc'd from this Paſſage alone, that in his Opinion, the Blood and Juices irrigating the Body, flow backward and forward through the ſame Canals like Water from one Veſſel to another, reciprocally flowing from that to the firſt thro' the ſame Pipe. However, we take Leave to add the Authority of *Ariſtotle* in this Point, if that can influence any one. He, in the 4th Chapter of his *Third Book of Animals*, ſays, *The Blood is derived from the Heart to the Veins; but the Blood does not arrive at the Heart from any other Part; for that is the Original and Fountain of the Blood, and its firſt Receptacle.* It is plain, that *Ariſtotle* argues here againſt thoſe who believed the Blood returned back to the Heart thro' the ſame Canals. So that if we have any Regard to *Ariſtotle*, the Opinion of *Hippocrates* is, that the Blood flowed and returned thro' the ſame Veſſel, as Water would do if put in Motion within a Canal cloſed up on all Sides, and at each End, which, in *Ariſtotle*'s Opinion, who allows with *Hippocrates*, that the Heart is the Fountain of the Blood, is impoſſible; becauſe Streams do not flow back to their Fountains. But that we may not believe, that *Ariſtotle* thought that the Blood, which does not return towards the Heart the ſame Way it paſſed, any more than Streams can return the ſame Way to their Fountains, did return back another Way, that is, from the Arteries into the Veins, read only what he ſays in the 5th Chapter of his *Third Book of the Parts of Animals. The Veins proceed from larger into leſs, till they become ſo narrow as not to be capable of conveying the Blood.* And indeed, if *Ariſtotle* was as ignorant of the Circulation as theſe Words of his prove he was, it is not credible that *Hippocrates* knew it, or that *Ariſtotle* diſcovered any Traces of it in his Writings.

A DISSERTATION UPON THE Circulation of the Blood in *Born Animals* and *Embryons*.

DR. *Harvey*, after others, has explained and demonſtrated the Circulation of the Blood, which Phyſicians imagined peculiar to born Animals. Any one who is but the leaſt converſant in that Art, will own that Phyſic receives great Improvement from that Demonſtration; but nothing is more ſerviceable in Life, nor can I imagine any Diſcovery to be more grateful to a Mind that is ſearching after the ultimate Cauſe of Things, that Cauſe which is known to God only, the Author of all Things, than to have diſcovered and acknowledged, that the *Original* of Animals ought to be derived from God himſelf. Becauſe it is now known, that the Blood is alternately received into, and expelled out of the Heart of the Animal; wherefore neither any Heat, or Ferment, nor a Fluid, however impregnated with Salts and Spirits, nor any other Force continually and not alternately impreſſed, expels the Blood, or nutritive Fluid, out of the Heart, or Region of the Heart: for if ſo, the expelled Blood would not return to the Heart, as being obſtructed by that Motion acting perpetually, and not alternately. But that Force alternately exerted in the Heart does not proceed from the Womb of the Mother; for what proceeds from the Womb to the Heart of the *Embryon*, falls down into the Cavity of its Ventricles, and not into the Ducts of its Fibres, where the Power of Contraction conſiſts: Beſides, that the Heart of an *Embryon*, when freed from the Womb, is contracted, and the Blood circulates. That Power then is to be derived from ſome Part of the *Embryon*. Now the Law of Circulation proves, that nothing is returned from any Part of the Animal to the Heart, which was not before conveyed with the Blood from the Heart to that Part; and I have my ſelf ſhewn, that the Secretion of Fluids in an Animal (either returning or unreturning Fluids) is performed by the Neceſſity of Circulation, which objects the Particles of the Liquid to be ſecreted equal to the Size of the Orifice of the Secretory, and that there is no other Mechanical Account of Secretion: and therefore that there are not only Secretory Veſſels and others exiſtent, before any aſſigned Secretion, but alſo that the Secretion of the Powers refunded for the Contraction of the Heart is performed before any aſſigned Conſtriction of the Heart, or before any Circulation is commenced; or that the Contraction of the Heart, which expels the Blood to the Part which ſecerns the Body, or Powers for the Contraction of the Heart is performed before any Secretion, or Refuſion, and Communication of the contractile Powers. Again, the Circulation ſhews us, that the Marrow of the Brain or *Spina Dorſi* is that Part, from whence the Force that expels Blood alternately is impreſſed upon the Heart: nor is there, by any Changes and Metamorphoſes common to ſome ſorts of Animals, any Alteration made in thoſe Powers, and their Relations, by which Life and Circulation does ſubſiſt in thoſe Creatures; and by conſequence the Communication between the Heart and the Marrow of the *Spina* is not changed. From whence it follows, that the Heart and the Medullary Subſtance have always a mutual Relation to each other by the ſame Powers, and operating in the ſame manner, and that this Relation exiſted in the ſame manner at the firſt Contraction of the Heart, as it does in a ſucceeding one. Wherefore the Powers of the Heart and Medullary Subſtance had the ſame Beginning, and act together; and by conſequence no Animal is ever produced Mechanically. And from hence I draw this Conſequence, that the Fluid derived from the Male brings with it an Animal into the Womb and *Ovaria* of the Female, which before enjoyed the Circulation of the Blood, and the Benefit of Life. And I know not whether they who ſtile themſelves *Theologians* and Interpreters of *Jove* ever produced any thing more worthy of *Jove*, or more glorious to Mankind.

1. But proceed we to other Matters, and explain ſome Qualities of the Circular Motion proper to the Blood demonſtrated by Dr. *Harvey*. Now we may collect them from what follows.

If a Fluid in which ſome ſolid Corpuſcles ſwim, flows thro' Canals, whoſe Sides converge to the Parts of Motion to which the Fluid it ſelf moves, or diverge from them, or if the Sides are parallel to the Line of Motion, the Motion of the Fluid is more eaſily and frequently obſtructed in the Canal, whoſe Sides converge to the Parts of Motion, than in a Veſſel of parallel Sides; and the ſame Motion is more eaſily obſtructed in a Canal of parallel Sides, than in one whoſe Sides diverge from the Parts of Motion. And farther, the larger the Angle of the Vertex of the Triangle thro' the Axis of the Canal in theſe converging Sides, is, the more eaſily and frequently is the Motion directed toward the Vertex obſtructed: but the leſſer that Angle is, the more eaſily and frequently is the Motion of the Fluid toward the Parts declining from the Vertex obſtructed.

2. It is evident, if the Motion is from the Baſis to the Vertex, *v.g.* of a truncated Cone, it may eaſily happen (if any ſolid Corpuſcles ſwim in the Fluid) that the Fluid may carry a Solid, which may cloſe up the narrower Orifice of the truncated Cone: Beſide, by the Poſition of Solids ſwimming in a Fluid, and their continual Alteration by ſtriking againſt the Sides of the Canal, it is hardly to be prevented, but that ſome of thoſe Bodies being at laſt conveyed into a Section of the Veſſel ſufficiently narrow, may mutually ſtrike upon each other, and being ſupported by the Sides concurring with the Line of Motion, compoſe a ſolid Arch, which will obſtruct all Paſſage. And it is evident that this Arch will be the firmer, as it is more forcibly preſſed by the ſucceeding Fluid. And in the laſt place it is plain, that this will happen more eaſily and frequently *cæteris paribus*, the more the Sides of the Cone converge, that is, the larger the Angle of the Vertex of the Triangle is thro' the Axis of the Conical Canal.

3. If the Sides of the Canal are parallel, and ſo the Canal it ſelf either Cylindrical or Priſmatical, *&c.* it is evident that the firſt

Cauſe of Obſtruction vaniſhes, ſince there is no Body which can enter ſuch a Canal, which cannot paſs thro' the Parts of it with the ſame Facility; but the other Cauſe ariſing from the caſual ſtriking of the Solids at Sections always the leſſer towards the Parts of Motion, happens but ſeldom, nor will that give any Obſtruction, ſince its Force ought to be encreaſed by the Force of the ſubſequent Fluid. This is alſo a Conſequence from what has been before laid down, ſince a Cylinder is a Cone, of whoſe Triangle thro' the Axis the Angle at the Vertex is the leaſt of all.

4. But when the Motion is in a Canal, *v.g.* which is Conical, from the Vertex to the Baſis, or thro' a Canal whoſe Sides diverge from the Parts of Motion, no Accident ariſing from theſe Reaſons obſtructing and ſtopping the Motion, takes place: ſince a ſolid Corpuſcle which enters the narrower Orifice of the Vertex, may very eaſily paſs thro' the larger Sections of the Canal, and the Corpuſcles cannot be ſo eaſily forced to ſtrike againſt each other, from the concurring Reſiſtances of the Sides; and if they accidentally ſhould compoſe an Arch, that being unſupported by the Sides of the Canal, would be eaſily carried away by the Force of the ſubſequent Fluid.

5. From whence it follows, that in the ſmalleſt Veins, and at their firſt riſe (in which from

their ſmall difference of their Diſtance from the Heart, the Velocity of the Blood is equal, as in the neareſt Arteries) Obſtructions do not happen ſo eaſily and commonly as in the Evaneſcence of the Arteries; and that the Motion of a Fluid is more eaſily obſtructed in the Arteries, than in the Nerves. For the difference of the Velocities in the Arteries and Veins may be diminiſhed to ſuch a degree, as to become leſſer than any given Quantity; and therefore the Velocity at the Evaneſcence of an Artery, and the Riſe of a Vein is equal. But the difference of the Reſiſtances and Obſtructions happening within the Arteries and Veins is not altered, tho' you aſſume the Sections ever ſo near their common Vertex, ſince the Angle comprehended between the Side and Axis of the Cone remains the ſame always, and in every Part.

From whence it follows, that in every Diſtemper, the Symptoms, which may as well ariſe from an Obſtruction of the Motion of the Fluid in the Arteries, as from a Stoppage of the Motion of the Fluid thro' the Veins and Nerves, it is always to be ſuppoſed, that the Fault is in the Arteries rather than in the Veins and Nerves.

6. Now we think fit to give an Inſtance of this in the ſoporiferous Affections of the Brain, *viz.* a complete Apoplexy, a Carus, Coma, Lethargy, and Palſy; which laſt, tho' not an Affection of the Brain, yet has a near Relation to an Apoplexy. They who have wrote upon theſe Diſtempers, have not ſcrupled to transfer the Cauſe of theſe Symptoms, which lies within the Veſſels, into the Nerves, or, as Dr. *Willis* ſpeaks, into the Pores of the Brain: whereas the Place of its Situation and Action is always within the Arteries, according to what we here prove. The famous *Sylvius*, in his 2*d* Book *Of the Practice of Phyſic*, diſcourſing upon the Apoplexy, has this Paſſage: *I am fully perſwaded, that the Animal Spirits may be made ſo heavy and devoid of Motion, that an Apoplexy may follow; ſince it is evident from Experience, that Men upon the taking a Quantity of Opiates, or Spirits of Wine, have fell into a Sleep and an Apoplexy.* The ſame Perſon, upon the Palſy, ſays thus: *It ariſes from a Fault of the Animal Spirits, as often as they are made heavy and motionleſs by Opiates, or a Dizzineſs.* And ſpeaking of a *Carus*, and a ſleepy *Coma*, *The Cauſe of theſe Symptoms*, ſays he, *is from an Induction of a Narcotic Power upon the Animal Spirits, which deprives them of their Motion.* And laſtly, the ſame Perſon, after a verboſe Diſquiſition about the Nature of Opiats, concludes in the

26th Chapter of the ſame Book, *That the Narcotic Power of Opium is join'd to its ſulphurous*, that is, *its oily Part, which renders the Animal Spirits ſluggiſh, inactive, and more unfit for Motion.*

What Dr. *Willis* has ſaid upon theſe Diſtempers amounts to the ſame thing. For he affirms, that they ariſe from the Admiſſion of a venomous Subſtance into the Brain, which either entirely extinguiſhes the Spirits, or forces them to retreat to the inner Parts. In his Chapter of a *Lethargy*, he ſays thus: *Opiates ſubdue the exteriour Power of the Spirits, ſo that the reſt being diminiſhed and chaſed into the inner Parts, are oppreſſed and deſtroy'd.* And becauſe the Nature of this Diſtemper cannot be explained, without accounting for the Cauſe of Sleep, it is worth while to hear what he ſays upon that Point, in the *16th* Chapter of the Phyſiological Part of his Book, *Of the Soul of Brutes. The Animal Spirits*, ſays he, *are the Subject of the Brain, not of the* Cerebellum, *otherwiſe the Pulſe and Reſpiration would ceaſe in the Time of Sleep.* Since the Nerves that move the Heart and Breaſt, according to *Willis*, proceed from the *Cerebellum*. Thus the exteriour Animal Spirits of the Brain, either by a voluntary Motion (to this Caſe he refers the Powers ariſing from Muſick, and Laſſitude after Exerciſe, in which Caſes he ſays the Spirits contract themſelves into a leſſer Space) or by the Incurſion of a foreign Body (to this he refers the Extinction of the Spirits by Opiates) withdrawing themſelves from the exteriour Pores of the Brain, where they uſually expatiate, retreat into its innermoſt Cavities, where they repoſe as it were at leiſure, and induce an equal Laſſitude upon the Spirits reſiding there, and reſtrain the Efflux of others, which would flow into the Nerves, and draw them into the ſame Repoſe.

7. All this ſhews that *Sylvius* and *Willis* believed, that the Nature of theſe Symptoms of Opium, and the Cauſe of Sleep, could not be explained by any other Means, than by the introducing an obſtructing Body into the Nerves, that ſhould hinder the Motion of the Fluid that paſſes thro' them. But we here ſhew that there is no ſuch thing; and by conſequence, that a Cauſe anſwerable to all Medicinal Uſes ought to be derived from a Body diſperſed thro' the extreme minuteſt Arteries of the Brain.

8. It ſeems ſtrange that theſe Perſons ſhould receive no Light from the reading of a Book publiſhed by the Learned *John Jacob Vepſær* upon the Apoplexy. For he in the 252*d*, 251*ſt*, and 250*th* Pages, and in many other Places, ſays, *The Head is dozed by Opium, by a plain Experiment, which is the notable Quality of Fermenting in Opium, or its converting into Vapours, (by which it turns the Serum into Vapours) and many of theſe Va-*

pours inſinuate themſelves into the Paſſages of the Animal Spirits, or Nerves, and in ſome meaſure obſtruct them; for Opium operates by ſtuffing the Paſſages of the Nerves to that degree, as to deny a Paſſage to the Spirits: which is more probable than the fancied Fixation of ſome Animal Spirits by the hot and ſudorific Qualities of Opium. So far this Great Man, who deſerves much of the Profeſſion of Phyſic.

9. It is plain that *Vepſær* was miſtaken, in placing the Operation of Opium in the Nerves, and not rather making it in the Veins. For there the Blood being in a quicker Motion, and warmer, is more eaſily turned into Vapours: And when it is converted into Vapours, it will neceſſarily diſtend the Arteries, and preſs round the Canals of the Nerves, and make its own Paſſage into them more difficult. But this is plain from what we have before demonſtrated.

That very Induſtrious and Learned Phyſician *Etmuller* would have done well in attending *Vepſær*'s Obſervations on this Subject: For *Etmuller*, in a Diſputation upon the *Diaphoretic Power of Opium*, publiſhed in the Year 1679, ſays, that Opium induces a certain Laſſitude and Heavineſs upon the Animal Spirits, and from them a Languor and Inactivity in moving the Fibres of the Organical Parts; for if we depend upon *Etmuller*'s Philoſophy, it reſtrains the Elaſtic Force of the Spirits.

He afterwards affirms, that there is no Alteration made in the Blood by *Opium*, ſince 2 Grains of *Opium* do not ſeem ſufficient to alter 20 Pound of Blood, and work upon ſo great a Quantity to that degree, as to reſolve the Animal into a Sweat. He allows indeed that 20 Grains of Volatile Salt will provoke a Sweat; but then he advertiſes, that thoſe 20 Grains ſeem better to anſwer the Quantity of 20 Pound, than the 2 Grains of *Opium.*

10. It is eaſy to obſerve, that we have anſwered theſe Notions in the *2d, 3d, 4th,* and *5th* Paragraphs of this Diſſertation. But becauſe I ſee many unwary Perſons every day drawn into Miſtakes by *Etmuller*, it will not perhaps be unacceptable to ſift his Doctrine with ſome farther Accuracy. For he ought to know the manner how *Opium* exerts its Powers, who pretends to give a Solution of the ſoporiferous Affections of the Brain.

It is plain from theſe Paſſages of *Etmuller* how difficult it is for one to diſentangle himſelf from Prejudices: For while he denies that the Blood is at all altered by Opium, becauſe the Alteration, which reſolves the Animal into Sweat, requires at leaſt 20 Grains of Volatile Salt of Hartshorn; but 2 Grains of Opium (more than which he thinks it unſafe to give) is very diſproportionate to that Quantity; he does not at the ſame time take notice, that 20 Grains of Volatile Salt are far more diſproportionate to an Ounce of Wine, if an Ounce of Wine will excite Sweat, or at leaſt from that Quantity of Wine which provokes Sweat in the generality of People. It is ſufficient, if the Force of Opium is to the Force of Volatile Sudorific Salt as 20 to 2, and to the Force of Wine as 480 to 2, if 480 Grains of Wine provoke Sweat.

11. But he does not at all explain what the Powers and Qualities of Opium are; nor does he inform us of any thing more than that the taking of Opium brings a Heavineſs upon the Animal Spirits, following the Expreſſions of *Sylvius* and *Willis*, (which *Vepſær* had clearly refuted) affirming that Opium acting not within the Arteries, but the Nerves, was the Cauſe of that Heavineſs, which is refuted by my Theorem.

I ſhall then diſmiſs this Subject, after obſerving that the famous *Etmuller* is evidently miſtaken, in affirming, that *Hectical* Perſons are freed from Night-ſweats by the adminiſtring of Opium. Here he has deceived himſelf; for Opium is proper for the quieting a Cough, which encreaſes Sweat by an immoderate Agitation of the Body; and if Opium is mixed with *Potter*'s *Antihectic* Powder, Salt of *Saturn*, and, as the beſt Phyſicians practiſe, with the *Jeſuits Bark*, it diminiſhes the Cough and the Sweats which that excites. But if Opium be given ſimply to Hectical Perſons, who have no Cough, it always excites Sweats. Thus much I have obſerved for the Uſe of young Phyſicians.

12. What I have deduced in the fifth place proves, that the Cauſe of thoſe Affections that provoke a kind of Sleep, exerts its Powers within the Arteries. I ſpeak of that Cauſe, which being ſituated within the Veſſels, produces thoſe Affections. Neither do I here diſcourſe of the Cauſes that coagulate the Blood, from whence we derive thoſe Affections ſometimes; for theſe ought to be placed within the Arteries, as the Thing it ſelf proves, and we have obſerved.

For whatever can coagulate the Animal Spirits, that will firſt coagulate the Blood, and ſo will not enter the Nerves; becauſe we diſpute of the Cauſe of thoſe Affections which reſemble a *Carus*, flowing or conſiſting in the Veſſels.

Theſe things being ſettled, we may now proceed to explain thoſe Narcotic Powers, which ſo many Phyſicians would have to be the Cauſe of the ſoporiferous Affections of the Brain.

13. The *Phænomena* or Symptoms mentioned prove, that the Sweat is provoked by the taking of Opium, the Blood being rarified, and cauſing an unuſual Diſtention of the Arteries, as the Pulſe plainly informs us; wherefore if ſuch a Quantity of Opium

is taken, as is able to rarify the Blood in the Brain to that degree, that the ſmall Arteries ſituated between the Nerves ſhall contract them extraordinarily, and deny a Paſſage to the Fluid inherent in the Nerves, the Animal will be thought to ſleep, and all thoſe Accidents will happen, which accompany ſoporiferous Affections derived from a Cauſe flowing thro' the Veſſels of the Brain.

The Heart will be contracted, and alſo the Muſcles which ſerve alternately for Inſpiration, becauſe both theſe Muſcles and the Heart have no Antagoniſts; and therefore a leſs Quantity of Liquor will ſuffice to contract them: But if the Force of Compreſſion be every where encreas'd, by encreaſing the Quantity of the Opium that is taken, the Nerves at the Heart will alſo be too much compreſs'd, which will make the Pulſe beat little and ſeldom, and at laſt be quite gone. Which thing not being obſerv'd by Dr. *Willis*, made him abſurdly, and contrary both to the Senſe of Anatomiſts and the Doctrine of the Circulation of the Blood, affirm, that the Nerves which ſerve for involuntary Motion, *viz.* the Motion of the Heart and the Thorax, are not affected by a Body which is ſaid to deſtroy what is in the Nerves of the Brain, altho' carried thro' the Arteries, which are all about the *Cerebrum* and the *Cerebellum.* Now if this was true, the remaining part of the Opium that is taken muſt be carried off by all the Arteries which tend not to the Brain, and compreſs all the ſecreting Veſſels that lie about the ſanguiferous Veſſels, which are dilated by the Rarefaction of the Liquid that runs thro' the ſmall Arteries. Therefore the Veſſels which make a Secretion of the Gall and Pancreatic Juice, are compreſs'd, and ſo (if the Morbific Matter of a *Diarrhæa* is ſecern'd thro' the Secretory, Pancreatic, and Biliary Ducts) a *Diarrhæa* will be thereby ſuppreſs'd; the Canals of the Kidnies will be compreſs'd, and the Animal will not be able to piſs. The Perſpiration thro' the Skin and Membranes will alone exert it ſelf, the ſudoriferous Pores which are in the Ends of the Veſſels, and in the Skin, not being ſtop'd or hinder'd from acting, by the Dilatation of the ſmall Arteries or other Veſſels compreſſing them more than ordinary. The Force of this Reaſoning lies in this, that how much ſoever the Perſpiration is encreas'd, it has no occaſion for particular ſecreting Veſſels, but throws it ſelf out of the Pores of any Veſſels, as well as ſecreting ones.

14. Whence it will be no difficult Matter to explain the ſoporiferous, anodyne, and aſtringent Force of Opium, better than we can be inform'd out of *Sylvius*'s or *Willis*'s Philoſophy; and to ſhew that Wine and all other Liquors that are apt and ready to rarefy, will be ſufficient to cauſe a Sleepineſs.

Nay it may be caus'd alſo by any Liquors, tho' not too apt to rarefy, if a Quantity large enough be taken, and ſo much of it be carried to the Brain, as to produce the requir'd Dilatation, and conſequently a Conſtriction of the Nerves. For this reaſon, it is no wonder that ſome People become ſleepy and drunk by drinking Water; neither will the Cauſe of it be any longer hid; for *(cæteris paribus)* the rarefying Force of Liquors, which cauſe an equal degree of Sleepineſs by different Quantities, is reciprocally proportional to the ſaid Quantities. Therefore any Volatile Salt will cauſe a Sleepineſs, and it is wrong to throw in any Remedy of that kind into the Veſſels to drive away an Apoplexy, unleſs the too great Viſcidity of the Blood require it: Neither muſt we uſe it to extinguiſh an Acid, for the Volatile and Acid Salt of Amber attenuates viſcid Blood; but any Volatile Salt may be applied outwardly to provoke Motion, juſt as is done with the Smoke of Vinegar.

Any body may eaſily underſtand, that if there be two Animals, alike in other reſpects, and having Nerves of equal Bigneſſes, and equally diſtant from one another, which have the Arteries of their Brain of unequal Contents, the Animal who has the greateſt Arteries will be ſooneſt drunk, and he that has the leaſt will ſooner have the Headach. For a greater Quantity is requir'd to thruſt out the Sides of a greater Artery to a given Degree of Tenſion, than the Sides of a leſſer; for the Quantity of Liquor muſt be as the Square of the Diameter.

15. I cou'd add to this what the Phyſicians of all Ages have ſaid of a *Vertigo*; but I will only quote two. The firſt is that *Caſſius* who publiſh'd Problems before the Year 1400. His Anſwer therefore to the Queſtion why circular Motions cauſe a Giddineſs, is this: *Circular Motions hinder Tranſpiration from being perform'd, the Air thruſting in vehemently and hindering it; and likewiſe as the Body is mov'd circularly, ſo are the Matters within us. Since therefore they are agitated together with us, and cannot tranſpire; even when the Cauſe of their Motion ceaſes to act, they continue to go round in a Circle. And ſuch a Motion of the Humours is the Cauſe why the Senſe imagines ſomething beyond Nature.* This is what he ſays, according to *Geſner*'s Tranſlation.

Think ye that Dr. *Willis* ſays any thing more to the purpoſe? Let us hear what he ſays in his *7th* Chapter of his ſecond Exerciſe *Concerning the Soul of Brutes: The Spirits in the Brain are like Water in a Vial, which is turn'd about together with the Veſſel that contains it; and when once a Vortex is made, the Water keeps its Motion ſome time, even when the Veſſel is at reſt: After the ſame manner, when a Man's Head is turn'd, the*

the Spirits in the Brain are whirl'd about, and have, as it were, ſpiral Motions, and ſome Parcels of them are obſcur'd, are carried here and there in Vortices, and often tranſverſly.

16. I ſhall omit what has been put out on this Subject in *Etmuller*'s Name; for it is evident that this Great Man wou'd have publiſh'd his Works with Emendations, if his ill Fortune had not hinder'd him: For all that was publiſh'd under the Name of *Etmuller*'s *Practice*, was only put out by ſuch as did it for the ſake of filthy Lucre. Which I here mention, leſt any one ſhou'd look upon thoſe things to be mine, which Bookſellers will perhaps put out contrary to my Knowledge, and give out that I dictated them to my Scholars.

I return to *Caſſius* and *Willis*. If they had known that the Obſtructions ariſe in the Arteries ſooner than in the Nerves or Veins, and that the Diſtention of the Veſſels produce the ſame Effects, as thoſe that are aſcrib'd to a Tumor, or a Matter that obſtructs thoſe Veſſels (when we don't know the Quality of that Matter) they wou'd not have taught that a Vertigo aroſe from the Liquor of the Nerves being whirl'd round; but they would have look'd for the Cauſe of it in the Arteries. For the Make of the Nerves and the Brain, diſcover'd by the moſt Ingenious *Malpighi*, hinders any ſuch Effect, and ſhews thoſe things to be falſe, which are alledg'd by *Caſſius* and *Willis*.

17. But tho' ſuch Symptoms cou'd be excited by the Liquor which flows thro' the Nerves, yet it is not right to attribute them to that Motion, which appears to be in things plac'd about us, that ſeem to turn round. Becauſe it is plain from Optics, that no Object appears remov'd out of its Place, as long as its Image remains in the ſame place in the *Retina*, and circumſcrib'd after the ſame manner: But the circular Motion of the Liquor in the Nerves and Filaments of the *Retina*, does not change the Place of the Image. Therefore we muſt not aſcribe the Giddineſs or *Vertigo*, which happens to People that turn round, to the Vortices of the Liquors. Therefore if we wou'd know the Cauſes of a *Vertigo*, we muſt look into *Lawrence Bellini*'s Book of the *Diſtempers of the Head*, where that Great Phyſician and Philoſopher demonſtrates, that a *Vertigo* is not occaſion'd by a circular Motion of the Animal Spirits, but (when it becomes a Diſtemper) by a Removal of the *Retina* or Nerve, by the Diſtention of the Arteries of the Eye. Whence it appears that he made uſe of ſuch Theorems as we do.

18. Hitherto we have diſputed of the Theory agreeing with ſome Diſtempers; now to ſhew the Uſe of our Theory, we muſt explain, what ſtead they may ſtand us in, in the Cure of thoſe Diſtempers. For in

ſoporiferous Diſeaſes, generated after the manner here mention'd, firſt of all we muſt open the Arteries or Veins; all ſtimulating Medicines muſt be us'd; but ſuch Salts as are commonly call'd Volatile, and Spirits drawn from Harts-horn, Urine, and ſuch Subſtances, and ſuch Remedies alſo as are call'd Cephalic, are not to be us'd. I know very well how many People I ſhall have upon me for this Aſſertion; but having exactly demonſtrated the Matter, I don't value the Opinion of the Multitude. Then I adviſe, that in a *Vertigo* we muſt not uſe any of thoſe Volatile Salts, but ſuch things as hinder the Rarefaction of the Blood: I ſpeak of the Cure which muſt be made after neceſſary Evacuation. For it is evident that in an *idiopathical* or *original Vertigo*, no leſs than in an Apoplexy, the Arteries and Veins muſt be open'd; but in any other the Patient muſt be made to vomit, and that for ſeveral Reaſons. For firſt of all a Vomit waſhes away the Filth of the Stomach, and the Paſſages for Perſpiration become more free, which being ſuppreſs'd, had ſo encreas'd the Quantity of the Blood, as to cauſe a *Vertigo*, for the Reaſon ſhew'd by *Bellini*. Then that Liquor is waſh'd out, which afterwards being mix'd with the Blood, wou'd either have caus'd the Blood to encreaſe too much in Quantity, or to be too much rarefied, and by that means have produc'd a

Vertigo. There are alſo other Caſes when Vomiting is neceſſary, when the Diſtemper ariſes from a foul Stomach.

19. But let us ſee what Method of Cure agrees with *Willis*'s Theory. We know by Experience, that it is good to open a Vein in Apoplexies, (Obſerve here, that we ſpeak of ſuch an Apoplexy whoſe Cauſe is within the Veſſels) and that ſuch an Help does by manifeſt Reaſon expel ſuch a Narcotic Force as we ſpoke of. Now if the Spirits in an Apoplexy become unmoveable or torpid, by a ſoporiferous Body's being admitted into the Nerves, as *Sylvius* believ'd; or if the Nerves be ſo clogg'd up by ſuch a Body, as to hinder the Spirits from paſſing thro' them, as *Vepfærus* will have it; or laſtly, if Bodies cauſing Apoplexies kill the outmoſt Companies of the Spirits, or their Centinels that ſtand at the Gates, as *Willis* teaches, we muſt let Bleeding alone, and have recourſe to a new and unknown kind of Remedy. For I don't believe that opening a Vein can recal to Life Companies of dead Spirits, and raiſe up the unmoveable and torpid ones, neither that it will draw out or diminiſh the Matter which clogs up the Nerves: But Volatile Salts, as they call them, and Spirits drawn off from Animal Subſtances by Chymical Fire, will be made uſe of by famous Men, but with very ill Succeſs. For I have ſaid before, and again affirm, that ſuch Salts

and Spirits make an Animal ſleepy, and like Opium, dull the Senſes, and ſtop the Journey of the Spirits thro' the Nerves. But you muſt take care not to compare a Grain of Opium with a Grain of Volatile Salt; for one Grain of Opium often produces the ſame Effect as ſixty or more Grains of that Salt.

20. Having a great many Reaſons to ſuppoſe that the Nature of Opium muſt be like the Salts of Harts-horn, I perſwaded Mr. *Alexander Monteith*, an excellent Man, and a very famous Surgeon well skill'd in Chymiſtry, to make ſome Chymical Experiments upon Opium: He, having often try'd the thing, ſhew'd me five Ounces and five Drachms of a Volatile Spirit (as they call it) drawn from a Pound of Opium, which perform'd the ſame *Phænomena* as Spirit of Harts-horn, and beſides from the Opium was drawn off an Ounce and 2 Drachms and a half of fetid Oil, and laſtly the *Caput Mortuum*, which ſmell'd like Harts-horn, weigh'd 7 Ounces and 6 Drachms. So that it is no wonder if the ſame things are perform'd by Volatile Salt, and Spirit of Harts-horn, as by Opium, if a Quantity fit, and prov'd by Uſe, be taken into the Stomach.

I don't know whether it be worth while to obſerve what *Sanctorius* ſays in the 18*th Chapter*, *Sect*. 4. of his *Statics*, that he himſelf experienc'd, namely, that he perſpired more ſleeping than waking: becauſe from what I have already ſaid, any body may know the Reaſon of it, eſpecially if the Sleep be cauſed by rarefying Medicines, and apt to occaſion Sweating. And the Force of it conſiſts in this, that Opiates cauſe Sweat, and that That which cou'd not obſtruct the ſmall Arteries, cannot obſtruct the Nerves.

⁂

A
DISSERTATION
CONCERNING
The Cure of FEVERS by EVACUATION.

PHYSICIANS believe that continu'd Fevers ariſe from the ill Quality of ſome Liquor or Body, exciting thoſe Symptoms which every body knows to belong to Fevers; to which Body or Liquor they have given the Name of Morbific Matter. Some will have that Matter to be a Humour, which is commonly ſecreted in healthful Bodies, but ſo chang'd in the Sick, as to occaſion the Symptoms of Fevers; and which of it ſelf, that is, by the natural Puſh of the Blood, cannot be ſecreted: Some ſay that it comes from without (calling it the *Miaſma)* and joining it ſelf to the Liquor which muſt naturally be ſecreted, excites

Fevers. No matter which of theſe are in the right: for all things will happen in the ſame manner, whether the Morbific Matter invades from without, or the Humour within be chang'd into Morbific Matter.

2. Phyſicians embrac'd theſe Opinions, after they had obſerv'd that moſt People in Fevers are depriv'd of the Tranſpiration thro' the Skin, or that other Evacuations, which belong'd to them as Animals, are ſtop'd or diminiſh'd. But theſe appear'd almoſt evidently to thoſe who obſerv'd how Fevers went off; for ſome appear'd to be carried off by Sweating, others by Plenty of Urine, and others by a Looſneſs; and that there wou'd be a *Criſis*, when the Secretion was provok'd thro' any of thoſe Glands which carry the Humour out from an Animal. Wherefore they imagin'd that there was ſome ſort of Matter that fed the Diſeaſe, which was to be expel'd from the Body of the Patient, after it had been made ready to flow, or ſo chang'd (by cauſing a Concoction and Digeſtion, as they call it) as to be eaſily rooted out of the Body.

We ſhan't diſpute of that ſo much celebrated Concoction, but only enquire what kind of Secretion or Evacuation muſt be us'd in Fevers, if any is to be us'd. In which Enquiry we ſhall ſay nothing at all of the Cure by Blood-letting, becauſe we are reſolv'd only to conſider thoſe Evacuations which are commonly made in a ſound Animal by Ways naturally open to them, and which Phyſicians endeavour to provoke, after Blood-letting, when they think it neceſſary, and Vomiting, if that be neceſſary; and indeed it is often ſo.

3. But becauſe now a days a great many People are of Opinion that Fevers ariſe from the ill Quality of the Ferments, which they ſuppoſe to belong to every Part, or to the ill Quality of the fermenting Parts of the Blood; and Smatterers like this Opinion mightily, ſetting up for Philoſophers and Phyſicians, when they have got a few Words by the end: I thought fit to give an account of this Subject in the Words of the moſt Ingenious *Nicholas Steno*, in his Preface to his Diſſertation *Concerning a Solid naturally contain'd in a Solid.* Theſe are his Words:

Beſides the ſubtil Fluid which goes thro' all things, we obſerve at leaſt three kinds of Fluids in Animals, the firſt of which is External, the ſecond is Internal and Common, the third Internal and Proper to particular Parts.

By the External Fluid in Animals, I mean that Fluid which not only encompaſſes the Fluid that we ſee like an Atmoſphere, but alſo touches the remaining Parts of the Surface of the Animal continu'd thro' the larger Holes, as the whole Surface of the Aſpera Arteria, *the whole Surface of the* Way of the Aliment, &c. *Then,* he ſays, *I call that the Internal Fluid,*

Fluid, which does not communicate with the External, but by the intermediate Paſſages or Strainers of the Capillary Veſſels. *The Internal common Fluid is that which is contain'd in the* Veins, Arteries, Lymphatics, *and perhaps in the* Nerves.

The proper Internal Fluid is that which is round about the Capillary Veſſels of the common Fluid, and is different according to the difference of the Places in which it is, &c.

Then he adds, that the Reaſon why in different Places different Juices are excreted from the ſame Blood, depends upon the Places themſelves, which, he ſays, is explain'd *by the three following Conſiderations.*

I. *The Conſideration of the Capillary Veſſels of the internal common Fluid, which alone is regarded by thoſe Men that aſcribe all to a ſtraining thro' divers Pores, of whoſe Opinion I have been for ſome time.*

II. *The Conſideration of a Proper internal Fluid, which alone obtains with thoſe that aſcribe a particular Ferment to every Part, who may be partly in the right, tho' the Term of* Ferment *is built upon a Compariſon taken from too particular a thing.*

III. *The Conſideration of the Solid of every Part, which is follow'd by ſuch, as by attributing to every Part its particular Figure, pretend to know ſomething proper to each Part, which indeed we know nothing of, and which according to the Knowledge that we have hither-*

hitherto had of Matter, can be nothing elſe than the porous Surface of that Solid, and the ſubtil Fluid going thro' thoſe Pores. I ſhou'd, ſays he, *make too great a Digreſſion, if I ſhou'd apply what I have laid down to the Explication of what daily happens in our Bodies, and can be explain'd no other way: it is enough to hint here, that the Particles, which after various manners are ſeparated from the external Fluid, are carried into the internal common Fluid, by Strainers, from whence being alſo ſecreted different Ways, and being by a new Straining tranſmitted into the internal proper Fluids, they are by Appoſition joined to the ſolid Parts after the manner of Fibres or* Parenchyma's, *as they are determin'd by the Property of each Part, unknown to us, and included in the Conſideration of the three things aforeſaid.*

4. But although in our Diſſertation of the *Circulation of the Blood through the ſmalleſt Veſſels,* we have ſhewn, that ſuch Ferments are not found in the Bodies of Animals; yet, to be underſtood by thoſe who cannot comprehend a Mathematical Demonſtration, we ſhall explain the thing ſo, that even Beginners may eaſily know what we mean. From what *Steno* ſays, it is plain that the Queſtion is, how it comes to paſs that ſo many different Liquors are ſecreted out of the ſame Blood, and after what manner? Why Bile in the Liver, Urine in the Kidnies, and other Liquors in other Parts? The

Antients attributed it to a different Attraction, which Opinion may be better illuſtrated now by ſuch as underſtand Sir *Iſaac Newton*'s Philoſophy, than it cou'd then be by them. Since that time a great many Phyſicians having thrown out the Word *Attraction*, wou'd have this performed by Ferments, which they ſuppos'd to be different in the different Glands or Strainers of different Kinds. But we have ſhewn that there are no Glands, which ſhould be look'd upon as Strainers bor'd with Holes of different Diameters. We have alſo ſhewn, that the Orifices of all the Veſſels are ſimilar, and circular: whence it follows, that the firſt and third Conſideration of *Steno* are of no force. But it follows alſo, that if with theſe Men you lay aſide Attraction (which if you admit there will be no need of Ferments) for want of Glands that have Paſſages of different Figures, the Ferments, or thoſe internal Fluids which are proper to every Part, muſt be all waſh'd away and carried off by the Force of the Blood going thro' the Arteries. And if any are ſtop'd, that may happen as well in one place as in another, being ſtay'd by no difference of the Places (which is not any where ſuppos'd) and therefore the Secretion will be made thro' any part, without regard to any Ferment.

5. I have often wonder'd, that ſo many People wou'd ſuffer themſelves to be impos'd

upon, when at the ſame time they boaſted their Knowledge of the Nature of things: A great many of the Antient Phyſicians and Philoſophers aſcrib'd to every Part of the Body, Qualities, or a Temperature made up of Qualities, by whoſe help, they ſaid, the Secretions and Actions were directed. Our Authors of Ferments juſtly look'd upon thoſe Qualities and *Temperatures* as a Refuge for Ignorance, becauſe they had been invented without Foundation, built upon no *Phænomena*, and known only by Name. Therefore they ſaid, that every Part had its particular Ferment and Secretion. But the Nature of no one of thoſe Ferments is better known to theſe great Improvers of Phyſic, than the particular Nature of the Temperatures were to the Antients. Neither is any Property of the Ferment of any particular Part better known to theſe Adepts, than the Nature of occult Qualities to a Peripatetician. Whence it is too plain, that this Contrivance has introduc'd no new thing in Phyſic, except Words, as I juſt now ſaid in my Diſſertation *concerning the Circulation of the Blood thro' the ſmalleſt Veſſels*, when I ſpoke of the Glands.

6. Let us proceed to other Matters. We have ſaid, that it is obſerv'd that Fevers go off by encreaſing the Secretion thro' the Skin, ſometimes by encreaſing the Secretion through the Renal Glands, or by cauſing a *Diar-*

Diarrhœa thro' the Glands of the Liver, of the Pancreas, or the Inteſtines. We need not ſpeak of other Kinds of Criſes, unleſs any one will add to the reſt the Jaundice, which ſometimes comes upon a Patient as the Fever goes off.

Then we obſerve, that there are no ſecreting Veſſels, and no Glands in our Bodies ſerving for Secretion, which cannot be encreas'd to ſuch a Bulk, as to be able to receive and ſeparate every Humour, even that which is naturally apt to be ſecreted in other Glands. For we have obſerv'd that in the Jaundice, the groſs Liquor which is naturally ſecreted in the Glands of the Liver, is then ſecreted in the Cuticular ones, and that the too great Influx of Saliva thro' its Glands is ſtop'd by cauſing the Patient to ſweat, and drawing off the Salival Liquor by the Cuticular Glands, we ſee that a *Diarrhœa* is ſtop'd by turning the Humour into the Paſſages of Tranſpiration open'd by Sudorifics, and that a Spitting cures a Looſneſs, and that a Looſneſs being again excited, the Spitting will ceaſe, which alſo, as well as other Secretions, is taken off by an abundant Flux of Urine.

7. It is obſerv'd in Fevers eſpecially, how often any Liquor may go thro' any Paſſage dilated by Art or Nature, tho' there is no kind of Fever but what goes off for the moſt part by the Glands, or rather by Sweat thro' the

Pores, ſooner than any other Secretion: therefore there is no kind of Febrific Matter, but what can be brought out thro' the Glands deſign'd for Tranſpiration. For tho' part of the Blood (whether upon account of the fault of ſome Secretion, and an Hindrance of the Motion of the Humours, or the ill Quality of the Fluid introduc'd thro' the Chyliferous Veſſels) or any Humour may be forc'd or chang'd into any Nature, yet that is not the thing wanted, but we wou'd only know in what Condition of Corruption it is chang'd or perverted, when it cauſes Fevers.

For the Solution of which Problem Experiments muſt be made uſe of, which ſhew that it is a Property of the Febrific Matter, to be able to go off thro' any Veſſels, which uſually happens. But this thing will be more manifeſt from what follows, where we muſt conſider, in what proportion the natural Secretions are, and what Reaſonings may be deduc'd from the Knowledge of it to ſerve our preſent Purpoſe.

8. Namely from the 59*th* Aphoriſm of the firſt Section of *Sanctorius*, the Excretions made in a given Time have commonly this Proportion, that if the

Excretion by Stool be as 4,
That by Urine is as 16, and
That thro' the Pores of the Skin as 40, or more.

It is plain by this that Perſpiration is a Secretion which is double the Sum of the other Secretions (we take here the mean Quantity of the Perſpiration) and twelve times as great as the Excretion by Stool. Here we muſt obſerve, that the Excretion thro' the Mouth made by Reſpiration (which as *Sanctorius* in his 5*th Aphoriſm*, Sect 1. ſays, does amount to about half a Pound a Day) muſt be aſcrib'd to Perſpiration; for the Veſicles of the Lungs are no leſs expos'd to the Air than the whole Skin: neither can the Tranſpiration breaking out of the Veſſels and Veſicles of the Lungs, be naturally hinder'd, any more than that which is made at the Skin thro' the Veſſels that end there. For the Perſpiration is made thro' the Pores of the Veſſels that are expos'd to the Air. There are therefore ſudoriferous Veſſels like lengthen'd Canals (tho' we ſhall make uſe of that Term with the Vulgar) in the Skin more than in the Lungs, in which there are no ſudoriferous Canals. If therefore, to return to my Purpoſe, that Excretion thro' the Mouth be added to the Perſpiration, the Cuticular Excretion will be the Triple of the Sum of the others, and fourteen times more than the Excretion by Stool. Wherefore the Perſpiration will be at leaſt ten times as much as the laſt mention'd Secretion in our Country. For the Perſpiration ariſing from the Lungs is equal to the

Exceſs which one may aſcribe to the Perſpiration at *Padua* more than in *England*.

9. Becauſe Fevers (and ſeveral other Diſtempers) ariſe as well from the Suppreſſion of the Cuticular Secretion, as from any other Suppreſſion, and that that Suppreſſion is double, or even triple of any other; therefore the Suppreſſion of half or a third Part of the perſpirable Serum, will generate a Fever equal to that, which wou'd be occaſion'd by the Suppreſſion of all the other Secretions together. And becauſe the Cuticular Secretion is at leaſt ten times greater than that by Stool, therefore the Diminution of the tenth part of the perſpirable Serum will raiſe a Fever equal to that which the Suppreſſion of the Stool wou'd occaſion. For the ſame Reaſons the Help of half or a third Part of the Perſpiration will be of as great Service in expelling a Fever, as the Help of all the other Secretions together; and the Help of a tenth Part of the Perſpiration will be of as great Service, as the whole Excretion by Stool, and the whole Perſpiration will do ten times the Service as ten times the Excretion by Stool.

10. It is evident, that ſince the Matter of any Secretion may be carried off by encreaſing any other Secretion, and any Secretion may be encreas'd in any proportion by a proper Medicine; and laſtly, ſince Secretions may be ſo encreas'd, as to have the

ſame Proportion as they naturally have, therefore a greater Quantity of Morbific Matter may, in a given time, be drawn by a Cuticular Secretion, than by any other, in proportion of the Quantity of the Cuticular Secretion which naturally happens, to the Quantity or Weight of any other natural Secretion. Wherefore a Diſtemper will ſooner be carried off by making an Evacuation thro' the Pores of the Skin, than by any other Secretion, and that in the proportion mention'd; eſpecially where the Pores of the Skin are very much open, after the manner declar'd at the End of the ſecond Section, which will be repeated in the 12*th*.

From this it follows, that a Diſtemper can't be ſo eaſily remov'd by encreaſing the Secretion by Stool, as it can by encreaſing the Cuticular Secretion, unleſs the Increaſe of the former be to the Increaſe of the latter in an inverſe *Ratio* of the Secretions, or as the Quantity or *Moles* of the latter is to the Quantity of the former in a ſound Body. Wherefore the Secretion by Stool muſt be an hundred times greater than the natural, that there may be as great an Evacuation made in the Space of one Day, as is made by a Perſpiration ten times greater than the natural in the ſame Time; or elſe he muſt have a hundred Stools, who in a State of Health us'd to have but one; and two hundred or three hundred, if he us'd to have two or three. But he that in one Day in a State of Health us'd to have ten Stools, muſt when ſick (if he wou'd be cur'd by Stool) have a thouſand Stools a day.

11. Then it follows from the Premiſſes, that if you have any Fever under hand (the ſame holds in any Diſtemper ariſing within an Animal) that it is ten times more probable to cure it by Sweat than by Stool. For ſince the tenth Part of the Perſpiration, or a Perſpiration thro' the tenth Part of the Skin, is equal to and as eaſily caus'd as the Secretion by Stool; therefore the Probability of the Cure to be effected by Perſpiration is ten times greater than the Probability of the Cure by Stool. For it appears that there is but one Chance for this laſt, and ten Chances againſt it, that is, as many as there are Quantities of Perſpiration equal to it. And therefore the Expectation of Stool is as 1 to 11, and the Expectation of Perſpiration as 10 to 11. (See the famous *Hugens*'s Book *Of Reaſonings on the Play of the Dice.)* Therefore the Expectation of Perſpiration is ten times greater than that of purging by Stool; or the Value of the firſt Expectation is ten times the Value of the laſt. Now it is the part of a prudent Phyſician to make uſe of the moſt probable Means of Cure.

I ſaid that Fevers are for the moſt part driven away by Sweat, or by encreaſing the Perſpiration ſo as to make it ſenſible.

Sanctorius, in his *9th Aphoriſm*, *Sect.* 1, 2. ſays, that any cold Weather that happens in Summer hinders about a third Part of the Perſpiration, and that unleſs it becomes ſenſible, it generates Corruption, or Sickneſs. Thus far he ſays. But by Sweat or encreas'd Perſpiration I mean that that happens when the Humours are concocted.

12. We have hitherto ſpoken of ſuch Secretions which are encreas'd by a Medicine taken inwardly, and paſſing thro' the Ways where the Blood circulates. Wherefore, what has been ſaid of Secretion by Stool, has a Regard to that which is perform'd in the Glands of the Liver, of the Pancreas, and of the Inteſtines, the Encreaſe of which Secretion is made by Medicines properly purgative, or acting upon the Animal beyond the firſt Ways.

For as to the Excretion which is made by help of lenitive purging Medicines, or freeing the firſt Ways from the Foulneſs ſticking in 'em, they need not be any more referr'd to Purgation, or the Encreaſe of Secretion by Stool, than the waſhing of the outward Skin ought to be. For theſe Lenitives only promote the Perſpiration of the Inteſtines like that of the Skin, and to be aſcrib'd to it; for when the Pores of the Inteſtines are open, a greater Quantity of Perſpiration breaks out, than from an equal Quantity of the outward Surface of the Body. And theſe Pores are open'd by Medicines waſhing off the Filth, and chiefly by proper Emetics.

No wonder therefore, if when the firſt Ways are foul'd and daub'd over with too much Filth, by making uſe of a ſoftening Medicine which juſt waſhes, there appear ſometimes manifeſt Tokens of Concoction, and a neceſſary Quantity of Sweat breaks forth, the Inteſtines promoting it, when by an abſterging Medicine they are eas'd of the Burden of the Filth.

We muſt here obſerve, that the Proportion of Secretion given by *Sanctorius* obtains in healthful Bodies, in which this excellent Phyſician has examin'd all that is voided by Stool, made up of what has paſs'd the Lacteals, and what not. But we chiefly ſpeak of the Excrements ſent down from the Maſs of the Blood thro' the Hepatical and Pancreatic Ducts, and alſo by the Paſſages of the inteſtinal Glands. For in Bodies that are healthful and take no Phyſic, this Excretion thro' the Ducts, which draw their Liquor from the Maſs of the Blood, is very ſmall in Quantity, and ſcarce perceivable in thoſe that go to Stool but ſeldom. Wherefore the *Ratio* of the Cuticular to the Ventral Secretion will be much greater than the *Ratio* of 10 to 1, or even greater than the Ratio of 100 to 1. What may be deduc'd from hence is obvious to any one.

13. Let there be two elaſtic Canals having ſimilar Orifices of unequal Diameters; let them receive at every Pulſe Quantities of ſimilar Liquors proportional to the Orifices; and from the Knowledge of the Elements of Mathematics it will follow,

Firſt, That if the Number of Pulſes in the leſſer Canal be greater than the Number of Pulſes in the great one, in an inverſe *Ratio* of the Orifices, the Quantities of the Liquid which flow in a given Time thro' the unequal Canals will be equal; but the Velocity of the Liquid flowing thro' the leſſer will be greater than the Velocity of that flowing thro' the biggeſt, in a *Ratio* of the Pulſes.

Secondly, If the Number of Strokes or Pulſes in the greater Canals be greater (that is, if the Turns in which the great Canal receives its Liquor, come quicker in the ſame Time, or are more in Number than thoſe in which the ſmall Canal receives its Liquor) the Quantity of the Liquor flowing thro' it in a given Time, will be greater than that flowing thro' the other in a *Ratio* compounded of the *Ratio* of the Number of the Pulſes of the Greater to the Number of the Pulſes of the Leſſer, and of the *Ratio* of the Orifice of the Greater to the Orifice of the Leſſer; but the Velocity of the Liquor flowing thro' the great Canal will be to the Velocity of the Liquor flowing thro' the ſmall one in the given *Ratio* of the Pulſes.

From whence it follows, that where the Pulſe is more quick than naturally, that is, where the Number of Strokes or Pulſes is greater in the *Ratio* firſt given (as it happens in Fevers) the Velocity of the Liquid going thro' the Arteries is greater than the natural, tho' the Pulſe is leſs than the natural, that is, the Canal is leſs, and not ſo much dilated. Then if the Number of the Pulſes in the great Canal be greater, that is, if the Pulſe be both quicker and greater than the natural, the Quantity of the Blood going thro' in a given Time, that is, in the compound *Ratio* mention'd in the ſecond place (this is often the Caſe in Fevers) and the Velocity of the Blood will be in the *Ratio* of the Pulſes, or as the Quickneſs of the Pulſe. Let thoſe whoſe Buſineſs it is, ſee how theſe *Phænomena* of the Pulſes may be explain'd by a Circulation of the Blood ſlower than the natural, aſcrib'd to Fevers by ſeveral Pretenders to Phyſic.

This is what I thought fit to ſay of the Cure of Fevers by Evacuation. But take this Caution along with you, *viz.* that it is abſurd at any time to ſay that Fevers are cur'd without any previous Evacuation. For we did not intend to ſpeak of that kind of Phyſic, but only to ſhew the Ignorance of thoſe who have lately wrote, that Fevers were ſooner cur'd by a purging Medicine than one that promotes Perſpiration.

14. Since I have ſo often ſpoken of Perſpiration, I beg leave here to explain and demonſtrate *Bellini*'s Theorem; of which, tho' it is a very fine one, no body that I know of has given a Demonſtration. This is the Theorem.

> *The whole Quantity of Perſpiration coming out of a* Villus, *or hollow Fibre, or ſmall Canal, whoſe Weight is one Scruple, is the thouſand two hundredth Part of a Scruple.*

This I will ſhew from the following Method.

Sanctorius has affirm'd, that what is perſpir'd in the Space of 24 Hours, weighs 50 Ounces, which Ounces amount to 1200 Scruples, that is, 50 + 24 ℈. Therefore in the Space of one Hour we perſpire 50 Scruples, and every Minute of an Hour $\frac{50\,℈}{60}$, or the Quantity of 5 Weights, 6 of which make one Scruple. And as the mean Weight of a Man's Body is 160 Pounds, which are at leaſt equal to 60000 Scruples, or 50 × 1200 ℈, every Hour, from the whole Body will perſpire a Quantity not leſs than the thouſand two hundredth Part of the whole. And therefore, every Part will in the ſame time emit the two hundred thouſandth Part of it ſelf, or in the ſpace of every Hour each

Scruple will emit by Perſpiration $\frac{1}{1200}$ of a Scruple.

Now in a Man, the Sum of whoſe *Villi*, thro' which Perſpiration is perform'd, is the ſixtieth Part of the Body, or of about 3 Pounds, the ſaid Sum will be of at leaſt 1000 ℈. Now thro' this 1000 ℈ of *Villi* muſt be ſweated out every Hour 50 ℈ of perſpir'd Matter, or thro' 1 ℈ every Hour will paſs out $\frac{50\,\text{℈}}{1000}$ or $\frac{1\,\text{℈}}{20}$. Wherefore in the Space of one Minute, or $\frac{1}{60}$ of an Hour will perſpire (out of 1 ℈) $\frac{1\,\text{℈}}{60 \times 20}$ or $\frac{1}{1200}$ of a Scruple, as was found by that eminent Man *Lawrence Bellini.*

15. And becauſe the Weight of the Perſpiration, *cæteris paribus*, anſwers to the Weight of the perſpiring Body, therefore in a Body weighing 120 Pounds, or 45000 Scruples, the Perſpiration of 24 Hours will be equal to 900 Scruples, and the Perſpiration of every Hour to 37 $\frac{1}{2}$ Scruples. Therefore every Hour the Perſpiration of the whole Body (and therefore of every Part and Scruple of it) will be the thouſand two hundredth Part of it, becauſe 45000 ℈ are equal to $1200 \times 37\frac{1\,\text{℈}}{2}$.

Laſtly, in ſuch a Body, whoſe outer Skin or *Cuticula*, together with the Skin of the Womb, Lungs and Inteſtines, made about two Pounds, the Sum of the *Villi* thro' which the Perſpiration paſſes at laſt, is not leſs than 750 Scruples, or the *60th* Part of the Body: for the Body was of 120 Pounds, or of 45000 Scruples. Now thro' 750 Scruples every Hour $37\frac{1}{2}$℈ were to paſs out, or thro' 1 Scruple $\frac{37\frac{1}{2}℈}{750}$, which are equal to $\frac{1℈}{20}$ becauſe 20 × $37\frac{1}{2}$ are equal to 750. Therefore every moment, or every *60th* Part of an Hour, there went out (thro' a *Villus* or ſmall Canal of one Scruple) $\frac{1}{60\times20}$ of a Scruple, or the thouſand two hundredth Part of a Scruple. *Which was to be ſhewn.*

A Short DISSERTATION CONCERNING The Effects of *ACIDS* and *ALKALIES* in the Cure of Diſtempers.

MOST of the Writers of the laſt Age, who have treated of Phyſic, or at leaſt ſuch of them as are now eſteem'd, have affirm'd that moſt Diſtempers did ariſe from an Acid Body flowing in our Blood. Some others of late have affirm'd, that all Diſtempers are occaſion'd by too great an Influx of an Alkalic Body, or too great Plenty of Humours. Ignorance and Lazineſs, beſides an eager Deſire of Gain and Fame, produc'd theſe Sects; for it was eaſy to inculcate the common Notions of Acids and Alkalies, and with thoſe two hard and ſounding Words to gain the Applauſe of the common People. Let us then examine the Matter in a few Words.

2. They that deduce all Diſtempers from an Acid or Alkali, ought to give ſome certain Meaning to thoſe Words: for if you ſay that an Acid is ſuch a Body as takes away a Diſtemper, when (as is ſuppos'd) it has imbib'd an Alkalic Salt, you both deceive your ſelf, and occaſion a Diſpute about a Word, and ſhew that you don't underſtand what an Acid or an Alkali is. One might as well ſay, that all Diſtempers and their Cures ariſe from a Terreſtrial and a Celeſtial Matter, calling that Terreſtrial which is corrected by the Celeſtial, and Celeſtial that which is moderated by the Terreſtrial. But it is evident, that unleſs a certain Meaning be fix'd to theſe Words, the Diſpute among Phyſicians about Acids and Alkalies becomes as uſeleſs as a Diſpute about a Terreſtrial and a Celeſtial Matter: for ſince theſe Words have no certain Signification, and there may be infinite Kinds of the Terreſtrial and Celeſtial Matter, differing in Subtilty of Parts, Purity, and Simplicity of Miſtion; as there are infinite Kinds of Acids, differing in Volatility, Fixity, and Purity, and one Acid is deſtroy'd by another. Hence it follows, that if a Diſtemper be ſuppos'd to be occaſion'd by ſome Acid, we don't from that

A Short

DISSERTATION

CONCERNING

The Effects of *ACIDS* and *ALKALIES* in the Cure of Diſtempers.

MOST of the Writers of the laſt Age, who have treated of Phyſic, or at leaſt ſuch of them as are now eſteem'd, have affirm'd that moſt Diſtempers did ariſe from an Acid Body flowing in our Blood. Some others of late have affirm'd, that all Diſtempers are occaſion'd by too great an Influx of an Alkalic Body, or too great Plenty of Humours. Ignorance and Lazineſs, beſides an eager Deſire of Gain and Fame, produc'd theſe Sects; for it was eaſy to inculcate the common Notions of Acids and Alkalies, and with thoſe two hard and ſounding Words to gain the Applauſe of the common People. Let us then examine the Matter in a few Words.

2. They that deduce all Diſtempers from an Acid or Alkali, ought to give ſome certain Meaning to thoſe Words: for if you ſay that an Acid is ſuch a Body as takes away a Diſtemper, when (as is ſuppos'd) it has imbib'd an Alkalic Salt, you both deceive your ſelf, and occaſion a Diſpute about a Word, and ſhew that you don't underſtand what an Acid or an Alkali is. One might as well ſay, that all Diſtempers and their Cures ariſe from a Terreſtrial and a Celeſtial Matter, calling that Terreſtrial which is corrected by the Celeſtial, and Celeſtial that which is moderated by the Terreſtrial. But it is evident, that unleſs a certain Meaning be fix'd to theſe Words, the Diſpute among Phyſicians about Acids and Alkalies becomes as uſeleſs as a Diſpute about a Terreſtrial and a Celeſtial Matter: for ſince theſe Words have no certain Signification, and there may be infinite Kinds of the Terreſtrial and Celeſtial Matter, differing in Subtilty of Parts, Purity, and Simplicity of Miſtion; as there are infinite Kinds of Acids, differing in Volatility, Fixity, and Purity, and one Acid is deſtroy'd by another. Hence it follows, that if a Diſtemper be ſuppos'd to be occaſion'd by ſome Acid, we don't from that

Chymical Theory reſolve what Medicament to uſe, any more than if the Diſeaſe did not, or ought not to be ſuppos'd to owe its Origine to an Acid. Neither can one from ſuch a Theory know what ſort of Alkali to apply, not knowing what ſort of Acid caus'd the Diſtemper; neither alſo can it be known, whether an Alkali muſt be taken rather than an Acid, and be oppos'd to the Diſtemper; and if an Acid muſt be us'd, what kind of Acid it muſt be. Nay, it is a Mercy if a Phyſician with this Theory, does not in the ſame dreaming way define the Kind of the Acid, fit indeed according to his Theory, but in it ſelf pernicious. Let the Patients think themſelves well us'd, when they fall into the Hands of a Phyſician, who attributes nothing to his Theory, but all to Practice.

3. What remains therefore is, that we only learn by Uſe and Experience, what Remedy is proper for a given Diſtemper; for finding of which Remedy this Theory is of no uſe, as being built but on few Obſervations, and thoſe perplex'd; it can therefore impoſe upon no one but an uncautious, nor pleaſe any but a lazy Perſon, who is not us'd to the Labour of the Mind. And what I ſay of this Theory, I have before ſaid of any other Theory not built upon a ſufficient Number of Obſervations, nor after an Aſtronomical manner; that is, concerning all

ſuch Hypotheſes, which for want of a competent Number of Obſervations (and thoſe faithful ones) have not carried the thing ſo far, as to bring it to be treated of Geometrically. I have given an Example of it in the Diſtempers of the Eyes, (*See Sect.* 14, 15, 16, 17.) which, God willing, I will illuſtrate in the Edition of the Problems of *Caſſius Felix*, who was commonly called by the Name of *Iatroſophiſt*. *Bellini* gave an Example of it concerning letting Blood.

4. But to come to the matter: It is obſerv'd, that there is no ſort of Evacuation, but what may be perform'd in the ſame Man, the ſame way affected, as well by Alkalies as by Acids: For Sweat is occaſion'd by Acid Salt of Amber, and that Acid Volatile Salt which the *French* draw off from Silver and Tin. *See the Memoirs of the Royal Academy at* Paris *for the Year* 1692. The Bones of Fiſhes, of all Animals, any Blood, eſpecially that of a Goat, Salt of Harts-horn, and ſeveral other Alkalies, do likewiſe provoke Sweat. The ſame things are alſo Diuretic. But Spitting may be provok'd by Quickſilver, that has no Acid in it, and by corroſive Mercury made by an Acid, or the ſame Corroſive precipitated by an Alkali: It may alſo be occaſion'd by the Force of Cold ſhutting the Pores which ſerve for Perſpiration, or by a Stone ſtopping the Urinary Paſſages. Wherefore all Maladies

which owe their Origin to Evacuations either ſtop'd or too much encreas'd, are neither occaſion'd or to be cur'd by an Acid or Alkalic Body alone.

5. Blood-letting, which carries off ſeveral Diſtempers, and occaſions ſome, does chiefly ſhew that Diſeaſes owe their Riſe and Cure to other things than Acids or Alkalies. This alſo appears from the Monthly Courſes of Women, the Want of which occaſions ſeveral Diſtempers, commonly aſcrib'd to the vitiated Quality or Craſis of the Blood, whether ariſing from an Acid or Alkali; as Pains in the Head, Ulcers of all kinds, Inflammations, Convulſions, Fevers, *&c.* which all are carried off by the Return of the *Menſes*. Nay there is ſcarce any kind of Diſeaſe, but what may and does ariſe from the Encreaſe or Diminution of the *Menſes*, and may be carried off by their being reſtored to a Regularity. Here alſo we muſt obſerve, that if the Abundance of an Acid or of an Alkali cauſes all Diſtempers, Blood-letting or the Monthly Flux is of no uſe: for ſince ſuch a Body muſt be equally ſpread all over the Blood, it will go out of the Animal Body in proportion to the Blood emitted, or be retain'd in proportion to the Blood retain'd; and ſtill continues to be a Cauſe of a vitious Blood. I have always laugh'd at thoſe Men, which preferring an Hypotheſis to Experience, made uſe of that Argument againſt Blood-

letting, when they ought to have made uſe of it againſt the Suppoſition, that Acids and Alkalies were the Cauſes and Cures of all Diſeaſes; they might alſo have made uſe of it againſt the regular flowing of the *Menſes.* This was the Argument of ignorant Chymiſts, who did not know that Blood-letting did commonly let out the Morbific Matter, which is for the moſt part viſcid, and not prejudicial as it is an Acid or an Alkali; and the Blood by that means becomes fitter for Circulation and the Nutrition of the Animal; and that it carries off ſeveral Obſtructions, eſpecially Inflammatory ones, as *Bellini* has demonſtrated in his *Treatiſe of Blood-letting.* But if the Diſtemper was occaſion'd by any Salts freely wandering about the Veſſels, Blood-letting or the Monthly Courſes would be in vain.

6. Jeſuit's Bark ſhews, that the Cure of Fevers is owing neither to an Acid nor to an Alkali; for whether you call the Bark Acid or Alkali, you will ſee ſeveral things, which like it produce Acid and Alkalic Liquors, and Acid or Alkalic Salts, which yet do not carry off Fevers like this *Cortex.* For if you aſcribe the Cure only to the Acid or Alkalic Powers, you muſt aſcribe the Power of effecting that Cure to every other Bark, which has ſuch Acid or Alkalic Powers. And if you ſay that there are ſeveral Kinds of Acids, and alſo of Alkalies, and that one

Kind of Acids gives a Tincture to one Kind of Alkalies ſooner than others, ſuch an Aſſertion will ſignify nothing. For firſt, all thoſe things would expel Fevers, ſome indeed ſooner than others, there being different Intervals of Time, which does not happen; then you don't aſcribe the Cure to any Acid or Alkalic Body, but to a Body which is prov'd by Experiments to have ſeveral other Corpuſcles beſides the Acid and the Alkalic ones: and it is to thoſe Powers or Corpuſcles that the Cure of Fevers is owing. For if the Forces were of the ſame Kind, and only different in Degree, that is, in Quantity; any Acid or Alkalic Bodies would do the ſame as the *Cortex Peruvianus*, if a greater or a leſs Quantity (according as Uſe ſhewed) was given. For we know that it is not any Quantity of the Bark which expels a Fever. I believe the Experiment to be true, that an Infuſion of the Bark (commonly call'd *Quina Quina*) in Water, tinges with Red the Juice of *Heliotropium* mix'd with Water, as well as Acids do. But a Decoction of Saſſaffras Wood gives a redder Tincture to the Juice of the *Heliotropium* mix'd with Water, for which reaſon the Bark of *Saſſafras* ought to be more Acid than the Jeſuit's Bark: but yet Jeſuit's Bark cures intermitting Fevers much better. Laſtly, I caus'd ſome Chymical Experiments to be made upon Jeſuit's Bark: From two Pounds of it was drawn an Acid

Spirit, which ting'd with a red Colour five Ounces and a half of Solution of *Heliotropium* or *Turnſole*; the ſame ſort of Spirit was drawn off from ſeveral other Barks, not one of which could cure intermitting Fevers. Beſides, this very Acid Spirit drawn from Jeſuit's Bark does no good in intermitting Fevers: wherefore it is plain that in this caſe an Acid does no Service, neither can any Benefit be hop'd from any degree or difference of Acids. Moreover, if you ſay that one Acid or one Alkali differs from another, and that there are in the things themſelves ſome hidden Properties of thoſe Salts, then you fly off again from the boaſted Powers of Acids and Alkalies, and fall back ſhamefully to occult Qualities, and ſuch Trifles.

7. Tho' I have here argu'd concerning the Virtue of an Acid in the Cure of Fevers, yet it is not improper to take notice, that a Decoction of Chamomile Flowers in Water tinges Syrup of Violets with Green, Solution of Turnſole in Water with Red, and Solution of Salt of Saturn with White. Here we have a Marine, an Acid, and an Alkalic Salt; yet theſe Flowers carry off an intermitting Fever with the ſame Succeſs as the Bark, tho' of a quite different Virtue with reſpect to the Acid Salt. But before I proceed to other things, I cannot but take notice of thoſe Men, who us'd to object to me, when I gave my Lectures at *Leyden*, that

the Powder of the Bark muſt of neceſſity ſtick in the Stomach, not being able to mix with the Blood upon account of its Gravity, tho' at the ſame time we know that it ſwims in Water, Oil, Spirit of Harts-horn, and rectified Spirit of Wine; to ſhew what detriment is brought to the Art of Phyſic by the ignorant Induſtry of ſome Men.

8. Now for a Word or two to thoſe that deduce all Diſtempers from an Acid, and pretend to cure them with all eaſe imaginable with an Alkali. The Honourable Mr. *Boyle* has long ſince ſhewn, that there is no Acid in the Human Body; and yet how many cry, that the Ulcers in the Lungs ariſe from an Acid, and refer that ſharp Spittle, which *Hippocrates* takes notice of, to a corroding Acid? But, as I have often obſerv'd, there is nothing Acid in that Spittle, but a great Quantity of Salt, or of a Salt Body like Harts-horn; for this Spittle does not change Infuſion of Turnſole into a red Colour; but it turns Syrup of Violets into green, and makes the limpid Solution of corroſive Sublimate become white. Of the ſame nature is the Water drawn from the Belly of living Patients ſick of a Dropſy, as I have often experienc'd; and therefore they are quite miſtaken, who have long affirm'd without contradiction, that a Dropſical *Aſcites* is occaſion'd by an Acid gnawing the Lymphatic Veſſels.

9. But leaſt our Alkalic Phyſicians ſhou'd triumph, by ſaying, that even according to my Obſervations all Diſtempers may be carried off by Acids, I wou'd have them obſerve, that in many Fevers, Pains, Deliriums, old and inveterate Ulcers, and eſpecially of the Bladder, *Penis* and *Uterus*, the Bodies of Cantharides have prov'd very ſucceſsful, both apply'd outwardly to the Skin, and alſo taken inwardly into the Stomach. But eight Ounces of Cantharides by the help of Chymiſtry have afforded me 13 Drachms and a half of Spirit more Alkalic than Spirit of Harts-horn, 12 Drachms of Salt more Alkalic than Salt of Harts-horn, eight Drachms and a half of black fetid Oil, and three Ounces of *Caput mortuum* ſmelling like Harts-horn; which being applied to the Skin of thoſe that imagine no Remedies but Acids to have any Virtue, wou'd cure them of that Madneſs. But if, when the Madneſs is over, the Spaſmodic Motions, and Grief, and Deſpair of Succeſs, ſhould afflict them, they muſt make uſe of the Roots of Caſmunar Zedoary, and the wild Valerian, whoſe Decoction with Water tinges Syrup of Violets with Green, and Turnſole with Red, and which may alſo ſerve for a Remedy to thoſe who attribute all to Alkalies. The Patrons of either Sect will be cur'd by the *Ipeca-coanna*, or *Virginia* Snake-weed, if they have a Dyſentery, or want an Alexipharmacon: becauſe a De-

coction of theſe Roots in Water tinge Turnſole with Red, and Syrup of Violets with Green. But I am at a loſs to think how theſe Gentlemen will go about to cure themſelves; for it is pleaſant and uſeful to become a Philoſopher and a Phyſician in two Words. But a Philoſopher and Phyſician of this ſort, in order to diſprove my Opinion, will in vain have recourſe to white or black Hellebore, both which Roots tinge Turnſole with Red, and Syrup of Violets with Green; and therefore can neither be a pure Acid, or a pure Alkali.

10. Now I'll give you an eaſy Demonſtration of two Theorems deduc'd from the Honourable *Robert Boyle*'s Diſcoveries. The firſt is this:

There are no Fermentations of the Blood in the Human Body, ſince Mr. *Boyle* has ſhewn that there is no Acid in it.

Then, the Plants that we eat, how full ſoever of Acid they are, yet they are ſoon chang'd into Alkalies by the Action of the Stomach, and of the Lungs and Heart, which cauſe the Circulation of our Fluid; therefore Acids are ſo far from cauſing or curing Diſtempers, and of deſtroying the Alkalic Salts of the Blood, that Acids receiv'd into the Blood do rather beget an Alkalic Humour. No body doubts but that there is Marine Salt in the Blood, or a ſmall Quantity of Salt like Sea-Salt; and That the ſaid

Mr. *Boyle* ſhews evidently: But *Raymond Vieuſſens* has of late pretended to find an Acid in the Blood, having (as he ſays) endeavour'd to go farther than Mr. *Boyle*. This *Raymond* from fifty Pounds of Blood drew off half an Ounce of Acid Spirit, after he had mix'd in about an Ounce of Salt coming from calcin'd Blood, with three Ounces of Bole or Earth, by help of a reverberatory Fire. Theſe are his Words: Now the mean Quantity of Blood flowing in an Human Body ſcarce exceeds twenty Pounds, and therefore if what *Raymond* ſays be true, the Quantity of that Acid Liquor, which cou'd be drawn from the whole Maſs of my Blood, would not exceed an hundred Grains, in which Liquor there muſt be a great deal of Water: therefore that Salt may be look'd upon as nothing. But *Raymond* does not obſerve, that that Acid Spirit comes from the Bole; for three Ounces of Bole in Glaſs Veſſels have eaſily been made to yield about a Drachm and a half of Acid Spirit. I take every Day five Scruples of Sea-Salt at Dinner: *Raymond* unknowingly drew a Spirit from a Salt like this, or the Spirit or Acid Phlegm of the Bole. From theſe things therefore it is plain, that Sea-Salt quickly changes all Acid Salts into Salts like the Salt of Hartshorn, by the Force of the Circulation of the Humour flowing in the Body of the Animal; and that *Raymond Vieuſſens*'s great Book of

Principles is ridiculous almoſt from the Beginning to the End.

But to return to the Matter, I have found by Experiments, that the greateſt part of the Remedies of the fierceſt Diſtempers have nothing in them of Acid or Alkali, or of a Body made up of both: and therefore that thoſe who aſcribe the Cauſe or Cure of all Diſtempers to Acids or Alkalies, are altogether in the wrong.

* * *

SOME OBSERVATIONS Concerning *Womens Monthly Courſes.*

1. IF young Animals excreted as much as they take in, they would not grow; therefore in an healthful and growing Animal a greater Quantity of Blood is daily accumulated than has been or will be loſt. The Quantity of this accumulated Blood is known from the Encreaſe of the Bulk and Weight of the growing Animal. Hence it is plain, that in an Animal that has done growing, there is a greater Quantity of Blood accumulated than that which before was loſt.

2. For whilſt Animals grow, the Stomach, or the Heart, is encreas'd in ſuch manner, as to be in a Ratio of their Bulk; if we compare the Stomach and Heart with the other Muſcles and Membranes: But the

Forces of the Stomach and Heart are encreas'd in proportion to their Bulk; therefore the Encreaſe of Forces is proportional to the Encreaſe of Bulk. This is plain in the Heart, and in the other Muſcles, and therefore in the Stomach, if it has only the Force of a Muſcle; for from a greater Stomach, which has a greater Number of Glands, and abounds more with warm *Effluvia*, will proceed a greater Quantity of Ferment; and a greater Quantity of Heat will ariſe, either out of the Stomach, or the *Viſcera* next to it, which are encreas'd together with it; and for that Reaſon a greater Quantity of all ſorts of *Effluvia*, which, as ſome will have it, the Stomach throws out, to change the Food into Chyle.

3. Becauſe in a growing Animal the Ventricles of the Heart did receive and throw out a greater Quantity of Blood than what was equal to the Quantity loſt, that is, greater than the Nutrition and Reparation of the Body only would require; therefore it is plain, that when the Body ceaſes to encreaſe, there is alſo a greater Quantity of Blood generated in a ſound Animal, than what is ſufficient for the Nouriſhment or Repairing of the Loſſes of the Body: Since the Stomach and the Heart are encreas'd in proportion to the ſimilar *Viſcera*, and the Forces of ſimilar *Viſcera* are encreas'd in proportion to their Bulk. Therefore the Queſtion is, in what

Proportion the Blood is accumulated above that Quantity which is neceſſary for Nutrition, and to repair the Loſſes of the Blood loſt, in Animals that have done growing, and have not their Magnitude any way encreas'd.

4. Let us examine the Effect of this thing in ſome Animals. We obſerve, that in Women that have almoſt done growing, an *Hæmorragy* is every Month excreted through the Veſſels of the Womb, and they have a Flux of Blood out of their Body, during a Period known to every Body. If the Quantity of Blood expell'd at that time be divided by the Number of Days and Hours between two Courſes of Blood, you will have the Quantity of Blood which is daily and hourly added over and above what is loſt; and you will alſo find how much Blood muſt be accumulated that it may be able to make its Way every Month thro' the Veſſels of the Womb.

5. It is evident, that in Animals that walk erect, the *Momentum* of the Blood is leſs thro' the aſcending than thro' the deſcending *Aorta*; and therefore that in the ſaid erect Animals, the Blood is carried with a greater *Momentum* or Force through the deſcending Trunk of the *Aorta*, than thro' the aſcending Trunk of it in prone Animals. Then it is plain, that the Blood flows in greater Quantity through the deſcending *Aorta* in thoſe erect Animals, in which the deſcending

Aorta has a greater Number of, or leſs reſiſting Ramifications, than in thoſe that have fewer, or more reſiſting ones.

6. Now Women (who are upright Animals) have more and larger Ramifications from the deſcending *Aorta* than Men, namely the Arteries of the Womb, (I call deſcending *Aorta* any Ramification of it) then in Women the deſcending Branches are of leſs Reſiſtance than they are in Men. For thoſe that are in the Womb having no Support, are for the moſt part expos'd to the free and unreſiſting Air. And therefore in Females, (I ſpeak of erect Animals) ſooner than in Males, this Monthly Flux of Blood is frequent, and muſt paſs thro' the Womb.

Hence it will be plain, that prone Animals have not that periodical Flux of the Womb, nor erect Males, unleſs upon Account of ſome particular Cauſe. For we don't lay down as a Cauſe of the *Menſes*, ſuch a *Plethora* as is capable of breaking any Veſſels, *&c.* For Obſervations ſhew that only Veſſels of that Nature ſerve for that Flux.

Laſtly, We ſhall not hereafter wonder that ſome Difference is obſerved between thoſe Actions which depend upon the Brains of Males and Females, ſince from what has been ſaid it is plain, that a greater Quantity of Animal Spirits are ſecreted in a given Time in the Males than in the Females; and if we ſpeak of any other Flux, we ſhall find ſomething for our Purpoſe in the 65th and 66th *Aphoriſm of Sanctorius*, *Sect.* 1. where he has theſe Words; *The Bodies of Men in Health, who uſe very moderate Food, are every Month heavier than ordinary*, viz. *about one or two Pounds*; *and about the End of the Month they return to the uſual Weight, like thoſe of Women*; *but the Criſis is made by the Urine's being more plentiful or more muddy.*

From the following *Aphoriſm*, *Before the ſaid Monthly Criſis made by Sleep, either the Weight or the Wearineſs of the Body is ſenſible, and at laſt all things are quieted by a more plentiful Evacuation of Urine than ordinary.* *Note*, That we don't reckon as a Cauſe of the Monthly Flux, a *Plethora*, in reſpect of all the Veſſels, or that which happens in any Place, and breaks the Veſſels, however ſmall they are; but ſuch a *Plethora* as affects the Veſſels of the Womb, or thoſe Veſſels which are expos'd to the Air in the loweſt Place, *&c.*

Of the Encreaſe of the Quantity of the Blood in the Natural State, and the Proportion of that Encreaſe.

1. IF we ſhould every Day excrete as much as we take, we ſhould never grow, and there would be no Encreaſe of Body in young Animals.

2. Therefore in young Animals the Quantity of the Blood is encreaſed, and the Queſtion is, In what Proportion?

3. From the Encreaſe of Weight it is eaſy to know how much any one is grown; but becauſe that Encreaſe is ſo little every Day, that *Sanctorius* not weighing to a Nicety, look'd upon it as none, the Body muſt be

weighed not every Day; but every half Year or Year; and this Encreaſe of Weight thus found, and divided by the Number of Hours or Days, will give the Encreaſe of the Blood which nouriſhes each Day and each Hour.

4. But by this Encreaſe one may know how much the Blood, partly fluid, and partly join'd by Appoſition to the Fibres, is encreaſed, or the Sum of each Augment; for the fluid Blood is equally heavy with that which is harden'd, and the Blood which is accumulated does not immediately nouriſh and grow hard: but yet we can't know by Weight how much Blood is gone into Nouriſhment and Encreaſe of the Body, and how much the Exceſs of the flowing Blood in the Veſſels is ſeparate from each other, for every Day.

5. *Sanctorius* obſerv'd that the Excretion in Men was perform'd every Month by Sweat, Stool, Urine, or Hemorragy, more at one Time than ordinary; but that it often was made thro' ſeveral Places, ſo that the Evacuation made thro' any one Place is too little to be obſerv'd in a rude Manner; beſides, ſome of thoſe Evacuations are ſuch as may be attributed to an Accumulation made without the Animal, from which we cannot make an Eſtimate of the Quantity of the Blood.

6. Therefore the Quantity of the Encreaſe of the flowing Blood, which is not yet harden'd, muſt be found ſeparately from the Quantity of the Blood which is gone to the Nutrition and Encreaſe of young and growing Animals; it muſt, I ſay, be found from ſome Evacuation made in a ſufficient Quantity, and all at once, from the Blood Veſſels themſelves, and under the Form of Blood; for the Evacuation made by Urine is made from Places without the Animal, in which the Excrement may be accumulated, the Blood at the ſame time not being encreas'd.

7. Therefore to make an Eſtimate of the Quantity of the Blood ſeparately from the nutritious Blood, it muſt be done from the Evacuation of the Blood made all at once, and for a ſmall time, which may be long enough for Obſervation, but not made by any Ferment proper to the excerning Part; for we could not by that Method eſteem what is the Encreaſe of the Quantity of Blood; beſides, it has been ſhewn, that there are no ſuch Ferments in an Animal, and that there are no ſuch Difference of Pores in the Parts to which that Evacuation may be aſcrib'd.

8. Neither ſhall we here conſider any attracting Forces, either of the Blood, or of the Veſſels, or of any other Bodies; we ſhall only ſee what the Force of Gravity has to do in the Solution of this Queſtion, conſider'd

according to the Diverſity of Veſſels in ſome Animals.

9. Becauſe we ſee and conſider no Force of the encreaſed Blood, except that of Gravity; (for there is no other commonly known) it will be evident that that Evacuation muſt be made from the loweſt Part of the Body where the Sides of the Veſſels are perpendicular to the Horizon, and therefore the Force of Gravity greater.

10. But becauſe even in the greateſt Animals the Interval of the upper and lower Part is ſmall, therefore the Exceſs of the Gravity of the Fluid in the lower Part is very ſmall; therefore that deſir'd Excretion of the Blood muſt be made in that lower Part, or the Part of that Part which is interwoven with ſeveral Veſſels of ſmall Reſiſtance, that is expos'd only to the Air.

11. Whence it follows, that this Excretion is ſcarce obſervable in thoſe Animals which Nature has made prone, and ſuch whoſe lower Parts that are interwoven with Veſſels are not expos'd to the Air; or in which the Sides of the Veſſels which are expos'd to the Air tend not downward: Therefore no Brutes (except Monkeys, which go often erect) have ſuch a viſible Excretion.

12. Then it follows from this, that Women rather than Men muſt be liable to this Excretion, becauſe they have their Womb ſituated in the loweſt Part, having Veins

conveniently, the Veſſels expos'd to the Air, and perpendicular to the Horizon, their Sides being naked and looking outwards, and having nothing to ſupport them; therefore Women muſt have this Excretion thro' the Womb.

13. It follows alſo, for the ſame Reaſons that Men whoſe *Hæmorrhoidal* Veſſels are by any Means encreas'd and widen'd more than ordinary, may have ſuch an Excretion.

14. And in either Sex before the Blood begins to flow, there muſt be a Pain and Tenſion of the Veſſels, and all ſuch Symptoms as accompany Tenſion.

15. But the Quantity of Blood thus excreted every Month, divided by the Number of Hours and Days, will give the Quantity which every Day or Hour is generated, more than what had been carried off or ſpent in Nutrition that Day or Hour. Therefore it is no wonder if all thoſe horary or daily Quantities added together make up a Bulk of ſuch a Weight as to be able by its Gravity to break the Veſſels of the Womb, and cauſe a Periodical Flux almoſt every Month.

16. Wherefore the encreaſed Weight of the Body found every Day, if you take from it the Weight of ſuch a Part of Menſtrual Blood as belongs to it, will be the true Weight of the hardening Blood, or of the Blood which goes into Nouriſhment every Day or Hour.

17. We may ſay, that the Menſtrual Blood of Women ſweats out thro' the *Villi*, or ſmall Ends of the vaniſhing Arteries, or the Beginning of the Veins of the Womb, or from their Limits; or, becauſe the Arteries and Veins are continuous, and at their Meeting make a Parabolick Line, the *Vertex* of it being the ſaid Place of meeting, therefore we ſay, That the menſtrual Blood flows thro' the Vertices of the ſanguiferous Veſſels.

18. Now the Blood flows thro' the Vertices of the Veſſels in Women ſooner than Men, becauſe in Women there are more ſanguiferous Veſſels about the lower Parts expos'd to a free Space than in Men; for a Man is a Woman without a Womb. Therefore the Blood runs in greater Quantity to the lower Parts of Women than thoſe of Men, &c.

19. Therefore becauſe the Women have more ſanguiferous Veſſels expos'd to a free Space than Men, the Blood by its Gravity will diſtend thoſe Veſſels of the Woman, and tear aſunder the *Villi* or hollow Fibres, and ſo run out, as ſoon as the Women are old enough, for the Blood to be in ſuch Quantity as to fill up the other Veſſels of the upper Part of the Body, and that by it the Vertices of the Veſſels (that is, of thoſe which run along the inner Surface of the Womb) by repeated Impulſes and Gravitations are diſpos'd

pos'd to give Way to the pulling aſunder the *Villi*, hollow Fibres, or capillary Veſſels.

20. But this does not happen to the Females among the Brutes, which are naturally prone, becauſe the Veſſels of the lower Belly, and therefore of the Womb, are not more liable to be preſs'd by the Gravity of the Blood than thoſe of the Head, *&c.*

21. Let there be two People in Health, one of which has the Monthly Flux of Blood, and the Womb and ſeveral Veſſels, ſituated in the lower Parts, and expos'd to a void Space; and the other has no ſuch Parts; but in other Reſpects they are proportionable in Bulk, this Flux will happen by a Diſtraction or pulling aſunder of the *Villi* by the Gravity of a greater Quantity of Blood. For I have prov'd that there is no ſecreting Ferment, or Ferment which cauſes a Heat in any Part of the Body. We ſuppoſe all other things alike, except a greater Gravity, which alone is the Cauſe of this Flux.

22. The Veſſels in Women ought to be ſuppos'd no leſs firm than in Men: for from Gravitation towards the Inferiours alone, it is, that when Girls come to the Age of fourteen, the *Menſes* flow, and not in Men. Becauſe how firm ſoever the Hypogaſtrical Veſſels are ſuppos'd in Women, yet ſince their *Villi* are liable to be drawn aſunder, and are more urg'd to it than in Men, they will at laſt be pull'd aſunder;

ſunder; eſpecially ſince the Impetus of the Heart is equal in Men and Women, and therefore the Blood flowing in a greater Quantity to the lower Parts of Women than of Men, and yet not receiving a greater Impulſe from the Heart to force it out, and make it return by Circulation, of Neceſſity it will preſs with a greater Gravity on the inferiour Veſſels of Women, and at laſt run out, namely thro' thoſe Parts where it gravitates more, *&c.*

Note, That the Veſſels of the Womb are the loweſt of any, I mean of all thoſe Veſſels which are not expos'd to the free Air, or of ſuch Veſſels as run to the Parts which are not expos'd to the free Air. For the Legs and Feet are expos'd to the free Air; for which Reaſon the Ends of their Veſſels grow hard, and the Parts of the Inteſtines are alſo rubb'd by hard and moiſt Parts, which ſlip by them, whence their Veſſels grow hard. Therefore the Veſſels of the Womb are neceſſarily the weakeſt of any.

23. But it is to be obſerv'd, that the Inteſtines, and the external Parts, eſpecially the Feet, are always rubb'd with ſome kind of Solids, namely Filth, Cloaths, Shoes, and all other things which reſiſt the Touch; and that all the Parts of living Animals become callous by Attrition, and being touch'd.

24. In the Male the aſcending *Aorta* bears a greater Proportion to the deſcending one, than in the Female, that is, the Aſcendent is greater in reſpect of the Deſcendent, in a Man than in a Woman.

25. Hence in Men a greater Quantity of Animal Spirits is ſeparated in a given Time, *&c.* Then it follows from hence, that of neceſſity a greater Quantity of Blood muſt go to the lower Belly in a Woman than in a Man.

26. Then alſo the Effect of Gravity is equally diſtributed all over the Body of the Man, which exerts it ſelf, or is gather'd together in one part of the Woman, and made ſenſible.

27. Laſtly, Iron and Steel provoke this menſtrual Flux (at a proper time, that is, after the Bones having done growing, do not turn off the Encreaſe of the flowing Blood, becauſe this Flux does not happen to Girls before they come to Maturity and have done growing) by its Gravity, by which they encreaſe the Impulſe of the gravitating Blood, or by their Weight remove the Obſtacles which hinder the Blood, as it endeavours to flow out : as Mercury alſo does better by a Force of the ſame kind, but greater.

28. *Obſerve*, that Quickſilver and Steel carry off too great a Flux of the Belly, as well as too great a Monthly Flux, by equally

ly removing the Impediments of other Secretions, and ſo encreaſing them, as being by a circular Motion carried equally to all the Parts of the Body.

Eſpecially *take notice*, that a leſſer Capacity, and ſo the leſs Dimenſions of the *Thorax*, and a leſs Quantity of Veſſels requir'd to nouriſh it, and a greater Capacity of the lumbar and hypogaſtrical Region, &c. in Women than in Men, ſhew that the Diameter of the aſcending *Aorta* is leſs, and that of the deſcending one is greater in Women, &c.

1. Laſtly, a Foot of Mercury weighs as much as 14 Feet of Water: Whence the Gravity of Water is to the Gravity of Mercury as 1 to 14.

2. Air raiſes Water to 32 or 33 Feet.

3. Air raiſes Mercury commonly to 29 Inches.

4. The Gravity of Air is to the Gravity of Water nearly as 1 to 1000. And

The Gravity of Air is to the Gravity of Mercury as 1 to 14000.

Mercury riſes to 27 or 28 Inches.

Water riſes to 32 or 33 Feet.

The Gravity of Water is to Mercury as 1 to 14.

Which is agreeable to Experience, for

$28 \times 14 = 392$ Inches,

And

$33 \times 12 = 396$ Inches, a Foot being = 12 Inches.

Wherefore in the New Moons, *&c.* when the Water is raiſed to 14 Feet, the Air will be rais'd to 14000 Feet, and the Mercury in the Barometer will ſubſide one Inch.

Again, when upon any other account the Air becomes lighter, ſo that the Mercury may ſubſide one Inch, or the Air may be rais'd to the Height of 14000, the ſame thing will happen to Women, which would happen at the New Moons, unleſs they have been thus affected on the laſt New Moon.

All theſe things may be thus deduc'd.

We ſee no Ferment in the Periodical Flux, therefore there is an Accumulation in Animals which do not grow, that is, thoſe which only nouriſh themſelves, and repair what they have loſt of their Subſtance, do make up a Bulk equal to that which was loſt. For after they have done growing, the Force of the Stomach remains the ſame for ſome Years, *&c.* or rather, as I imagine, is for ſome time exactly, or only able to repair the Bulk (I mean the encreaſed Bulk.)

If the Force of the Stomach is encreas'd in proportion to the Bulk, all this will be plain.

That the Forces of the Stomach and Heart are encreas'd in proportion to their (encreas'd) Bulk, appears from the Encreaſe of the whole Body. For the Heart and Stomach are encreas'd in Bulk in proportion to the other Parts; but the Encreaſe of Forces is proportionable to the Encreaſe of Bulk, *cæteris paribus*; this is plain of every Muſcle, and ſo of the Heart, and alſo in the Stomach, if they have only the Force of a Muſcle.

But altho' (as Dr. *Liſter* would have it) it ſhould act by Fermentation, the ſame thing would be true, becauſe a greater Quantity of Ferment would be ſecreted from a greater Stomach, or a greater fermenting Putrefaction wou'd ariſe.

1. It was to be ſhewn, that when the Encreaſe ceas'd, then by the Force of the Heart and the Stomach (which *Viſcera* were encreas'd with their Forces in proportion to the other Parts; and therefore at the time of their Encreaſe made and drove out more Blood than the Nouriſhment of the Parts alone requir'd) more Blood is made and driven into the Artery, than the Nouriſhment of the Body requires, as long as one Body only is to be nouriſh'd.

2. Therefore that Part of the Blood muſt be evacuated thro' thoſe Parts where the Blood makes the greateſt Impulſe, when the Encreaſe of the Body ceaſes; I ſay it muſt be evacuated in thoſe Animals whoſe Veſſels are not capable to bear it.

3. How great the Encreaſe is of that Blood which does not nouriſh, muſt be found; and that being found, one may know why the Evacuations are for the moſt part Monthly.

Con-

Concerning the

INGRESS

Of the Diſtemper commonly call'd the

Venerea Lues or *Pox*.

1. EVERY Part of the Animal Body may be enflam'd, altho' without the help of any Contagion; and therefore alſo be ulcerated, without the Contact of any other Animal. For whatſoever retards the Blood or the Seed, or thickens them in the Veſſels, cauſes an Inflammation, which occaſions a Rupture of the Veſſels and an Ulcer.

2. In both the *Indies*, *Afric*, and the Southern Parts of *Europe*, where Men liv'd ſlothfully, and almoſt like Barbarians, forgetting or being ignorant of what *Moſes* enjoin'd in the 14*th* and 15*th* Chapter of *Leviticus*, the Filth or Particles of *Sanctorian*

Expiration, which was in them more thick and groſs, by preſſing the Genital Veſſels cauſed Inflammations, and an Ulcer, and *Gonorrhea*, and other Symptoms of the Effects of Debauchery (the ſame as I have often obſerv'd in Dogs, and much oftner in Rabbits) tho' they had never been at *Naples*, nor cou'd have the Contagion from that Place.

3. In the Southern Countries the Expiration is for the moſt part greater than in the Northern, and the Venereal Act more frequent. Wherefore if the Southern People do not pay a conſtant Obedience to the *Moſaical* Law (and ſome Parts of Animals will not be eaſily kept under Subjection, or be confin'd by the *Moſaic* Preſcription) it is no wonder that they, without any Contagion tranſmitted from their Parents, are ſeiz'd with thoſe foul Venereal Ulcers, whether it be the *Neapolitan* Diſeaſe or the Leproſy, or the Scurvy, which is a Northern Diſeaſe, ariſing from a Stoppage of the Exſpiration, and an Encreaſe of Gluttony ; for too much Eating and Drinking, without uſing any Exerciſe, ſtops Expiration.

4. The *Venereal Diſeaſe* among the Southern People is cur'd by the Uſe of a Decoction of *Guaiacum* Wood, *Sarſa* Root, ſharp-pointed Dock, Burdock, and ſuch things in Water. They are unwiſe who teach that *Sarſa*, *Guaiacnm*, &c. are good to

take away the Acrimony of the Blood; for I could extract nothing out of them but an Acid Spirit or Liquor. They give Relief by cauſing Sweat, and waſhing away the perſpirable Filth which ſticks about the Veſſels.

5. But ſince the Northern Filth is more denſe and heavy than that of the Southern People, as alſo our Blood is thicker than theirs, as being made out of Food which is not much warm'd by the Sun, they muſt be rubb'd and expell'd by heavier Metals, among which Quickſilver is of great Service. Therefore when the Northern People are troubled with a Leproſy, the Whites, grievous Pains, or a Scurvy accompanied with Ulcers, they muſt make uſe of *Mercury*: For a Leproſy, before the *Neapolitan* Diſeaſe was talk'd of, was cur'd by *Mercury*, and now it is no longer heard of.

6. If Gold be ground ſmall (as it may be) into ſuch little Parts, that their Surfaces in reſpect of their Bulk may be ſo great, as to make thoſe Particles as light as Water, and fit to ſwim in the Blood, theſe Diſtempers will more ſafely and ſooner be cur'd by Gold than Mercury.

7. Add to this, that he who firſt had that Diſeaſe, or Plague, did not get it from the *Effluvia* of others.

8. The Poiſon of Vipers, or Leaves of Tobacco thruſt into the Veins when they are open'd, immediately kill an Animal; and

yet taken in the Stomach does no hurt; nay, I my ſelf have given Arſenic to thoſe who, having the Belly-ach violently, could be eas'd by no other Means, and had receiv'd no Benefit from Opium, and Salt of Amber, or Salt of Hartſhorn taken in a great Quantity.

9. Hence it follows, that it is a barbarous Cuſtom, and unbecoming Men, to confine very innocent Citizens (who have the Misfortune to be hated by ſome of thoſe Prieſts who were raiſed up from the meaneſt of the People) to their own Houſes, and to forbid them all human Converſation, for trifling Cauſes, tho' they are infected with no Contagion.

10. Wherefore, after having adminiſtred a Vomit two or three Times, let Mercury be taken for two or three Days, twice a Day. When the Patient's Mouth begins to ake, let him abſtain from Mercury three or four Days, then let him be purg'd every other Day. When his Pain in the Mouth is over, let him take Mercury again; and let this Method be repeated till the Symptoms ceaſe.

The ſame Method will ſerve for a Leproſy, as I have ſaid before; afterwards the following Means muſt be us'd in either Diſtemper: Namely, let the Ulcers be waſh'd with a Decoction made of Roots of ſharp pointed Dock, *Helenium*, Sulphur, Allom, of each two Ounces; let all be boil'd in eight

Pound of Lime Water, till it be reduc'd to ſix, adding towards the laſt, of Water-Creſſes, Water-Trefoil and *Cochlearia*, an Ounce of each; when it is ſtrain'd mix with it a little camphorated Spirit of Wine. It will alſo be well to lay upon the Ulcers an Ointment that has in it two Drachms of red Precipitate, one Drachm of white Precipitate, two Scruples of Oil of Tartar *per deliquium*, and two Ounces of Pomatum: Let it be applied at Night, as the Patient goes to Bed: But it will be proper in the Morning, before the Ointment is laid on, to uſe the following Coſmetic Water, made with two Ounces of Litharge of Gold, a Drachm of corroſive Sublimate, and ten Ounces of Vinegar; let them infuſe for ſeven Hours in a Tinn'd Veſſel, and be often ſtirr'd; after the thick Part is ſubſided, let the clear Part of the Liquor be poured off, and when it is to be uſed, drop into it Oil of Tartar *per deliquium*, till it looks Milk white; then with a Feather lightly waſh the Ulcers with this Water, and then lay on the Ointment. In the mean time let the Patient drink *Guaiacum* Beer, made with putting two Pounds of *Guaiacum* Wood into two hundred Pounds of Beer that has not work'd, and boiling it till a third Part is conſumed. When it is ſtrain'd off, it muſt be made to ferment; and whilſt it is fermenting hang in the Liquor in a Linnen Bag half a Pound of Antimony not powder'd, and four Ounces of ſharp-pointed Dock: When the Fermentation is over, put this Beer in a Barrel, with a little dried Roſemary, and ſome Rinds of Oranges; add beſides the Juice of five or ſix hundred *Millepedes*; when the Beer is clear, let the Patient drink nothing elſe.

* * *

Concerning the

SMALL-POX.

I would have thoſe that are ſick of the Small-Pox *to be cured after the following Manner.*

1. I Would have the Patient be let Blood whilſt his Fever laſts; and tho' the *Small-Pox* begins to come out, ſtill be let Blood till the Fever is over.

2. When the Fever is over, and the Small-Pox is come out, (for if the Fever does not go off when the Small-Pox appears, ſtill the Vein muſt be open'd to carry off the Fever) let the Patient often drink any diſtill'd ſimple Water, to be had at the Apothecaries, that is without Taſt, into which you muſt infuſe for ſome Hours, without Fire, Sheeps Dung, and then add Syrup of white Poppy, or Opium, if the *Diarrhæa* leſſens. Let him drink Barley-water with *Laudanum* and Syrup of White Poppy. This Drink, which is often given in the *Variolæ Confluentes*, or Flux Pox, (as Phyſicians call it)

cauſes a Spitting, and cures by that means. Apply nothing to the Face, unleſs you would ſtill more hinder the Expiration which is already hinder'd, and bring back the Fever; the Day after the Small-Pox is broke out, give the Patient Water-gruel.

3. If the fifth Day after the Small Pox is broke out, or the ſixth, or the ſeventh, or eighth Day, the Small Pox goes in again, a Vein is to be open'd again, and Cantharides in Powder muſt be laid to the Neck.

If the Small be of the Confluent kind, when the Diſtemper is over, a Purge muſt be taken.

4. But it becomes me, who have but a little Time to live, being in my ſixty firſt Year, to behave my ſelf like a Man; for *Publius Syrus* ſays, (and I am alſo of his Opinion) that it is the Part of a Chriſtian, or of one that would behave himſelf as ſuch, *kindly to ſet a Man right who is out of his Way*, therefore I ſhall ſubjoin ſome Remedies very uſeful for thoſe who are troubled with Epilepſies, Palſies, or the Gout.

In an *Epilepſy*, or *Palſy*, after Vomiting and Bliſtering, give the Antiepileptic Tincture. To the younger Patients give Mercury and Broth with Earth-Worms. The Antiepileptic Tincture is made of wild Valerian Root, and white Dittany, of each ſix Drachms, of Caſtor, Pidgeons Dung, of each half an Ounce, ſix Drachms of the clammy Bark of Oak, half an Ounce of Cinnamon, as much of Roſemary Tops, two Ounces of Senna Leaves, Jallap and Turpeth half an Ounce of each; make a cold Infuſion of all in eight Pounds of white *French* Wine for ten Days.

When it is ſtrained, add Powder of Human Skull, and Shavings of Elks Hoofs, of each two Drachms, and four Ounces of Sugar; mix in four Ounces of Oil of Amber, and two Drachms of Spirit of Caſtor: Give two Ounces to a Patient of about ſeven Years of Age, and to an Elderly one four.

It is often good in Palſies to give this Tincture without the Purgatives, when the Diſtemper begins to go off. It is alſo good for the Patients to rub and chafe the affected Limbs ſtrongly before the Fire, and then to dip them in cold Water.

* * *

FOR THE

Arthridis, or GOUT.

PUrging Medicines will ſignify little; Vomits are of Uſe, and afterwards Mercury, given by little at a time. Apply to the Part where the Pain is *Meſues Balſam*, commonly call'd *Balſamum Guidonis*.

To thoſe Parts where the Gout is, apply continually Linen Clothes, wet with the following Liquor: Hot Spring Water eight Pounds, white or yellow Arſenic two Ounces, ſix Ounces of unſlack'd Lime; ſet altogether upon a ſlow Fire for 24 Hours.

If the Patient have a Pain in his Stomach, give him preſerv'd *Nux Moſchata*, Powder of the Sarſa Root, and Jeſuits Bark, but ofteneſt Oil of Cinnamon, and preſerv'd *Nux Moſchata*, and preſerv'd Ginger.

It will be good alſo for the Gout, to pour into twelve Pounds of White Wine or Beer, four Quarts of hot Milk, then having taken away the Curd put a Pound of Berries of Hawthorn in to the remaining Liquor, and boil all for half an Hour. Let the Patient drink a Pound of this, Morning and Evening.

OF THE

DIVISION

OF

DISTEMPERS.

ALL Diſtempers are either from the *Fluids*, or the *Canals*, or compounded of both, or without the Animal.

The Diſeaſes of the *Fluids* are either of the *Blood*, or of the *Liquors* ſecreted out of the Blood, either from their Encreaſe or Defect, and thence ariſes a vicious Quality, that is, a *Fever*.

The Diſeaſes of the *Canals* are a *Wound*, a *Tumour*, an *Ulcer*, an *Inflammation*, &c.

Therefore to the Diſeaſes of the Excretory ones belong *Sleepy Symptoms*, which are owing to the Defect of the Excretion in the Brain, and the *Palſy*, for the ſame Reaſon: But the *Epilepſy* ariſes from the Encreaſe, and the *Vertigo* from the Defect. *Madneſs* from the Encreaſe. A *Vertigo* is a Tumor or Obſtruction. A *Gutta Serena* is properly a Tumor of the Arteries of the *Retina*, or of the Optic Nerves, (for every Obſtruction is a Tumor) and therefore belongs to the *common* Diſeaſes.

A Suffuſion is a Diſeaſe *without the Animal*, and is a kind of an *Abſceſs* or Tumor, like a *Steatoma*, or Tumor of Fat.

The *Ophthalmia* (a Species of which the *Gutta Serena* is) is a Tumour with Inflammation, and therefore belongs to the *common* Diſeaſes.

An *Epiphora* belongs to the Encreaſe of Secretion, unleſs there be an Inflammation, and then it is a *compound* Diſeaſe.

An *Hæmorrhagy* of the Noſe is a Wound, and belongs to *common* Diſtempers.

A *Ranula* belongs to the *common*, being a Tumor under the Tongue.

An *Angina* or *Quinſie*, belongs to the *common*,, for it is a Tumor with an Inflammation of the Glands of the Throat, and often of the Muſcles.

An *Aſthma* is an Obſtruction, and ſo a Tumour (ſometimes ſchirrous) of the Lungs, and belongs to the *common* Diſtempers.

A *Pleureſy* is a *common* Diſeaſe, namely, a Tumor with an Inflammation.

A *Peripneumonia* is a greater kind of *Pleureſy*.

A *Pthiſic* is a *common* Diſeaſe, namely, an Ulcer of the Lungs or Kidneys, *&c.*

An *Empyema* is an Ulcer of the *Pleura*, and of the internal intercoſtal Muſcles, open'd into the Cavity of the *Thorax*.

A *Syncope* is for the moſt part a kind of *Aſthma*, and truly of the Heart.

A *Palpitation of the Heart* is a Convulſion, and that often of the Splenic Arteries.

The Diſeaſes of the *Stomach* are Diſeaſes *without the Animal.*

A *Stone* in the Kidneys or Bladder, is a Diſeaſe *without the Animal.* See Dr. *Liſter*, Part 2. *Of Springs, &c.* and he alſo ſays the ſame of an old Gout. Each of theſe Diſtempers is a ſort of Tumor.

* * *

All the Diſeaſes of the Inteſtines

BElong to the Encreaſe or Defect of Excretion, or to the *common* Diſeaſes. Likewiſe the Diſeaſes of the *Liver* and *Spleen*, except the *Hypocondriac* Diſtemper, which is a Diſeaſe in the Inteſtines, *without the Animal.*

The *Dropſy* is a Wound of the Lymphatics, and is a *common* Diſtemper.

The ſame may be ſaid of the Diſeaſes of the *Kidneys* and *Bladder*.

The *Green-Sickneſs*, or *Chloroſis*, is an *Anaſarea* or Tumor, &c. and is a *common* Diſtemper.

The *Hyſterical* Affection is of the ſame Nature as the Hypocondriac.

The other Diſeaſes of Women (beſides *Fevers*) belong to the Encreaſe or Defect of Excretion, (for the *Menſes* and *Lochia* or *Cleanſings* are Excretions, or at leaſt Wounds, as the *Hæmorrhagy*) or to the *common* Diſtempers.

* * *

OF THE

SCURVY.

AS the *Fever* is an ill Quality of the Blood, or of all that is to be excreted, whilſt it flows in the Veſſels, ſo the *Scurvy* is an ill Quality of all or moſt of the Things which are excreted, whilſt they flow thro' their excretory Ducts. Or,

The Defect or Encreaſe in the excretory Canals.

Note, That ſince the Humours to be excreted do not appear to be vitiated in the excretory Ducts, unleſs the Blood it ſelf be vitiated, therefore the Scurvy does not conſiſt in ſuch a Vitiation; wherefore we ſhall ſay, that the Scurvy is a Diſeaſe compounded of the Diſtempers of the Excretory Canals in Complication, that is, of the Defect of ſeveral of them in their Excretion, of the Augment of ſeveral, *&c.* and of the *common* Diſeaſes, and often Diſeaſes *without the Animal.*

From

From this Diviſion of Diſeaſes it is plain,

1. THAT the ſame Diſeaſe may often be referr'd to ſeveral Kinds; as for Example, a Fever is either of the *Sanguiferous Canals*, or of the *Excretory Canals*; becauſe it is often join'd with the encreaſed Secretion of Animal Spirits, *&c.* and a Derivation encreas'd on the Fibres of the Heart.

In that Caſe many Properties of Diſeaſes are diſcovered, and therefore ſeveral Methods and Indications of Cure.

2. It is eaſy thus to find a Method, or Indications will immediately appear. Becauſe ſuch things are known as will ſhew whether there be an Encreaſe or Defect, or a Wound or Tumor; therefore in theſe few Words are contain'd all the things concerning which our Anceſtors wrote whole Volumes in a diſputing way. For the Cure of

Ulcers, *&c.* is in ſome Meaſure known; and ſo by conſequence the Cure of Diſeaſes, which may be referr'd to Ulcers.

3. If a Diſeaſe be compounded of ſeveral Symptoms of different kinds, ſuch a Diſeaſe may be referr'd to what kind you will; but always to ſuch a kind as the *ſtrongeſt Symptom* belongs. *Note*, That the Pain is not always the ſtrongeſt Symptom; as for Example, in an Inflammation, that Symptom is ſaid to be the moſt urgent which can kill the Patient in the ſhorteſt time.

Now we muſt ſhew that the Diviſion here laid down agrees with the Method of *Cure* us'd by the *Phyſicians*; eſpecially with that which belongs to the Diſeaſes where Surgery is of uſe; which comes nearer to the Nature of ſeveral Diſeaſes according to our Diviſion; ſee the *Sleepy Diſeaſe*, p.

But we muſt firſt define what the *Scurvy* is, and it is plain, that the Scurvy is not a ſimple Diſeaſe; but ſeveral Diſtempers ſeizing the Patient at a time, which have nothing common to each other but the *Slowneſs of the Pulſe*, which does not beat ſo faſt as naturally it ſhould. Wherefore it is peculiar to the Northern Nations of *Europe*, whoſe Pulſe is naturally ſlower than that of others; and perhaps that ariſes from the Blood's retiring inwards, (ſee *Bellini*, Page 100, and Page 528.) which makes the Pulſe beat ſlow. Therefore Blood-letting is not good in ſuch a

Caſe; becauſe letting Blood will excite that Dimotion, or Removal of the Blood inwards, which is proper to the Northern People, and which gives us the Scurvy, and is the Occaſion of our ſlow Pulſe. But if this Diſtemper depends upon contrary Cauſes (ſuch as are the Cauſes of a quick Pulſe, as the *French* Climate, *&c.*) there will be excited a Feveriſh Dimotion, *&c.*

Therefore a *Scorbutic* Dimotion does not require letting Blood, that is, when we know that an inward Dimotion will follow upon opening a Vein; and therefore that is ſo ſeldom done, that it may be look'd upon as never done.

Wherefore we muſt not ſo much fear letting Blood in a Scurvy; but this Fear was introduc'd by fearful and ignorant *Germans.*

Therefore we ſhall rather ſay, that the *Scurvy* is a Complication of ſeveral Diſtempers different in Nature, except that *in all of them*, the Pulſe beats ſlowly.

When therefore ſeveral Diſeaſes ſeize on an Animal, the *Germans* miſtake ſuch a Caſe for one ſingle Diſeaſe.

No Wonder then, that the *Germans* are deceiv'd in the Cure of the Scurvy; becauſe not one but ſeveral Remedies are requir'd, it being a Complication of ſeveral Diſeaſes. And indeed if the greateſt part of the Diſeaſes (or Symptoms) may be taken off by moderate Remedies, then will the Scurvy be ſaid to be carried off by them, and that it is of ſuch a Nature as Dr. *Willis* calls *Sulphureo ſaline*, becauſe the Sulphur, or Heat, is the moſt prevalent. But if the greater Part of the Diſeaſes that have the Name of *Scurvy*, are us'd to be taken off by *Aromatics*, and the *Cochlearia*, *&c.* then that Scurvy will be of the Kind which *Willis* calls *Salino Sulphureous*, becauſe the Salt or Coldneſs prevails. But generally, the things call'd *naſturtian* and *antiſcorbutic*, prevail; becauſe commonly in this Caſe, the Pulſe beats more ſlowly, and ſuch Remedies occaſion a ſwift Pulſe.

Therefore the Diſeaſe which the *Germans* now call the *Scurvy*, the Ancients *Lienoſitas*, or Obſtructions, is compounded of a ſchirrous *Aſthma*, Ulcers of the Mouth and Legs, Pains in the Limbs, the Palſy, convulſive Motions, Looſneſs, a Stoppage of Stool, an *Atrophy*, and ſeveral *Exanthems* or *Enchymoſis's*.

But becauſe all have not theſe Symptoms, it happens that ſome have not the *Aſthma*, (then the Scurvy is ſaid to be hot from the manner of its Cure) and to them hot things or thoſe which are truly antiſcorbutic, as *Naſturtium*, *&c.* are not neceſſary or profitable: But if the Patient had an *Aſthma*, Aromatics and Medicines with Pepper would be of uſe, which are proper for an *Aſthma*, as alſo Steel and Pepper are good for a cold Scurvy,

Scurvy. If the Patient has a Pain in his Limbs, then it is good to breath a Vein, and give *Mercurius dulcis*, otherwiſe not.

If he has Tumours in his Stomach, or in his Colon, or any Sharpneſs there, then Steel is convenient. But if he has no Sharpneſs or Tumour ariſing from a ſharp and viſcid Humour, Steel will do no good, at leaſt there is no Need of it, *Mars* being only fit to attenuate what is viſcid, *&c.*

Becauſe of the Ulcers (if there are any) a Decoction of Guaiacum, with vulnerary Herbs, will be convenient.

If the Patient has the Palſy, give him thoſe Antiſcorbutics, which are ſaid to be hot.

But if he has convulſive Contractions in the *Oeſophagus*, *&c.* give him volatile Acids with Laudanum, that is, Salt of Amber.

And thus may the Cure of the Scurvy be eaſily perform'd, by reſolving it into the Symptoms of which it conſiſts, and whoſe Remedies are known.

Add to this, that ſtrong Purgatives are not convenient for the Scurvy, which is attended with Convulſions, becauſe they irritate too much. But they are convenient in a ſcorbutic Palſy.

Then, when there is a Looſneſs, you muſt hardly uſe any Purgatives; neither are the ſharp and pepper'd Antiſcorbutics good in that Caſe, *&c.* Laſtly, for Spots uſe *Anti-icterics*; for the Scorbutic Spots are livid, and almoſt black, as in the black Jaundice.

Wherefore the Method of Cure is not here (nor in any other Diſtemper) to be found out from the unknown Nature of the Cauſe; but from the known Cure of the Symptom. For I don't apply a Decoction of Guaiacum or Sarſa, *&c.* to Scorbutic Ulcers, becauſe they carry off the Acid, or fixed Salt, but becauſe they dry and heal other Ulcers, whatever be their Nature or Cauſe.

For Ulcers were cur'd, before Men thought of any Acid in them; for as *Celſus* ſays, *the Remedy was not found out after the Reaſon, but the Reaſon was look'd for after the Remedy had been found effectual.*

Note, That the Scurvy appears to be what the Ancients call'd *Cachexia*, ſee *Cælius Aurel.* B. 3. and *Sylvius*, pag. 704 and 705.

And tho' I have ſaid, that all the Symptoms which accompany the Scurvy have this in common, *viz.* a ſlow Pulſe; yet this is not always true, (See *Sylvius*, p. 705.) but then the Exception holds good only, when there is an Inflammation or Phlegmon, or a rambling Gout. And oftentimes alſo without this, thoſe that have the Scurvy are ſeized with an uncertain and wandering Fever, like an intermitting Fever, to which they are liable. Wherefore nothing is always common to this compounding Symptoms, whence the *Scurvy* is not a ſimple Diſeaſe.

Note again, That *Pechlin* (in the 177th Page of his Obſerv.) determines the Cauſe of the Scurvy to be a *Salſugo*, or a Mixture of an Acid and an Alkali, and that as the one or the other exceeds, the Remedies for the moſt Part muſt vary, or elſe that one muſt uſe ſaline Bitters, and volatile Medicines, ſuch as the volatile Salts, the *Cochlearia*, ſtringy Trefoil, *Strobylinum*, &c. which yet do not agree with a Patient ſick of the Scurvy, who is of a bilious Complexion, who ought rather to take things that have a ſmall Sharpneſs mix'd with Balſamic Bitters, as Spirit of Salt, or of Vitriol made ſweet with Spirit of Wine, to which if you join the Bitterneſs of Aloes, Myrrh, Wormwood, Centaur, you will have another kind of antiſcorbutic Remedy.

Water-drinking is a Cure agreeable with either Courſe, (as it is a Diſſolver of Acids and Alkalies) and chiefly drinking warm Water, whence Tea-drinking and a Decoction of Guaiacum Wood, and the Root of ſharp-pointed Dock in Water are all good.

The *Sleepy Diſeaſe* is cur'd by ſtimulating Medicines, (or ſuch as are fit to awake out of Sleep) that is, provoking the Secretion of the Spirits, namely, by Vomits, ſharp Purges, Caſtor with Vinegar held to the Noſe, Oil of Amber, Spirit of Hartſhorn, ſneezing Medicines, bliſtering Plaiſters, an Iſſue behind in the Neck, and an Electuary of Cephalics or Aromatics. Laſtly, opening a Vein will take away the Foulneſs, and that Stagnation which hinders the Secretion and Derivation of the Spirits, *&c.* The ſame will do for a Palſy.

An Epilepſy (which for the moſt part ariſes from a Repletion and Irritation) is cur'd by letting Blood, becauſe when the Blood is in too great a Quantity, it makes too great an Affluence of Spirits in the Brain, or an Encreaſe of Secretion, as an Irritation makes an Encreaſe of Derivation. For which Reaſon alſo Purging Medicines are convenient, becauſe they diminiſh the Quantity of the irritating Humours; for when the Spirits have more Acrimony than ordinary, they have the ſame Virtue as a greater Quantity; and for that Reaſon Vomits are uſed, and a *Setaceous* Remedy. Then a ſtrong Decoction of *Guaiacum*, to make a great Evacuation. Laſtly, Anti-epileptics, all which have a narcotic Power, or hinder the Derivation of the Spirits. You may ſay the ſame of native Cinnabar, for *Mercury* hinders the Emanation of the Spirits in the Brain, by compreſſing the Nerves that lie between the Arteries.

A *Vertigo* is a Tumour or Obſtruction, and is cur'd after the ſame Manner as an Epilepſy, that is, by what ever takes off a Stagnation. Wherefore alſo Anti-epileptics and Narcotics meet in the End; becauſe they rarify thick Blood, and hinder too great a Derivation of Spirits into the Heart, which give a Velocity to the Blood, and cauſe a Swelling of the Arteries in the Eyes, *&c.*

A *Catarrh* is cur'd by thoſe things that take off the Secretion about the Head.

A *Gutta Serena* is cur'd by ſuch things as take off *oedematous* or white ſoft and inſenſible Tumours, Purgatives, (if there be an *Opthalmia*, a Vein muſt be open'd) Sudorific Decoctions, Bliſtering Plaiſters.

A *Suffuſion* is cur'd like a *Steatoma*, *&c.* that is, a Depreſſion of a confirm'd Cataract is proper, as cutting off for a *Steatoma*.

An *Opthalmia*, or Inflammation of the Eyes, is cur'd like other Inflammations, namely, by Bleeding and mild Purges, and then repelling Medicines, Anodines, Digeſtives, and Reſolvents applied to the Part, or Diſſolvents. See *Riverius*, pag. 54 and 55.

An *Epiphora* is cur'd with Aſtringents, and ſuch things as turn the Secretion of the Serum another way; as alſo a Catarrh.

An *Hæmorrhagy* is cur'd like Wounds, by Bleeding and Vulnerary Medicines, *&c.*

A *Quinſie* is cur'd like Tumours accompanied with an Inflammation.

An *Aſthma* (except it be convulſive) is a Tumour nearly ſchirrous, and is cur'd (in Cachochymies) by a Vomit, which hinders the Encreaſe of the obſtructing Tumour, which would be occaſion'd by the Viſcoſity of the Stomach, *&c.* and by all attenuating Medicines, and which evacuates Tumours that do not come to a Suppuration. See *Riverius* pag. 100 and 101.

A *Pleureſy* is cur'd like other inflam'd Tumours, *&c.*

Spitting of Blood is cur'd like an *Hæmorrhagy*, that is, after the manner of a Wound.

A *Phthiſic* is cur'd like an Ulcer, as alſo an *Empyema.*

Vomiting is cur'd by Aſtringents, and Medicines which diminiſh Excretion, among which the moſt excellent is the Water of the perpetual Fountain at the Town of *Diſart* in *Fife*, that noble and chief Province of *Scotland*, where the PITCAIRNS have their Patrimony.

An Obſtruction of the Liver is cur'd after the ſame manner as any Tumour or *Schirrus.*

The *Jaundice*, like any other Obſtruction, namely, by ſuch Remedies as take off a Lazineſs, as (after Vomiting to remove the Obſtructions) Steel, Mercury and Gold-Duſt, which overcome thoſe Stoppages by their Gravity ; becauſe the Jaundice is an Obſtruction of the ſmall Glands, or a ſtuffing of them by a too thick and viſcid Bile, and it is followed by a diminiſh'd Excretion, or Secretion in the Liver.

But I might call back Fevers themſelves to this Diviſion, where the Pulſe is moſt quick.

For then a Fever is the encreas'd Secretion of Animal Spirits flowing to the Heart: Becauſe, ſince in a given Time a greater Quantity of Spirits is ſeparated, therefore an equal or a given Quantity is ſecreted in a leſs time, and ſo the Spirits fall more frequently in the Muſcles of the Heart, and the Motion of the Heart is more quick or frequent.

But if the Quantity of the Blood be encreas'd, (by the Diminution of any Secretion, the reſt not being encreas'd, as it often happens to thoſe that are going to have a Fever) then in a given time (I don't yet ſuppoſe the Pulſe chang'd) a greater Quantity will be expell'd thro' the Heart, and run thro' the Brain. Therefore in an equal time a greater Quantity of Spirits, that is, of nervous Juice, will run into the Nerves, from the Arteries of the Brain, and being ſecreted will be ſent into the Fibres of the Heart, which will cauſe a more ſtrong Contraction of them, and a ſtronger Expulſion of Blood from the Heart, propagated to more diſtant Places in equal Times, whence the Pulſe will be more frequent, and a Fever will be occaſion'd.

And this is the Reaſon why letting Blood is proper in Fevers, becauſe the Quantity of the Blood being diminiſh'd, the Secretion of the Spirits is alſo diminiſh'd.

But becauſe Blood-letting in ſharp periodical or intermitting Fevers, does not immediately help, when adminiſtred the common Way, there muſt be given, after the Patient has been made to vomit, the *Peruvian* or Jeſuits Bark, (call'd *Quina Quina*) or, what is better, Powder of Flowers of Camomile, then a Doſe of Steel, or Filings of Iron, and the Patient muſt ride on Horſe-back pretty often, which will be ſafer and more effectual.

From what I have ſaid, it is plain, that there's no ſuch thing as an Art or Method of Curing; but only the *Practice of it*, as *Virgil* ſays, and that Remedies were found out by Chance, and not Deſign, (except Blood-letting after the Circulation was known) and will ſtill be ſo.

2. That Phyſic therefore is the Remembrance of thoſe things which Uſe has ſhewn to be an effectual Remedy for ſuch and ſuch Diſtempers: For the Nature of the Bodies flowing or reſiding among the Veins is not known; and therefore it is by Obſervation only that we know what is proper for each Diſeaſe, after we have often experienced it to be ſucceſsful in that Diſeaſe.

3. But he appears to cure by Chance, not Deſign, who does the ſame things over again, which can't be done by others that try the ſame Way. And therefore that can't be attributed to Method or Art.

4. Whence either *Zacutus* the *Portugueze* cur'd by Chance, or was too much guilty of

Lying. By Chance, becauſe if he had known ſome of the Caſes of which he was ignorant, and improv'd by it, they that came after might have follow'd his Steps in Phyſic.

5. Therefore, as an Example of Cure, or of the Way of applying Remedies, we muſt propoſe the Cure of a Quartan Ague, by giving the Jeſuits Bark or Chamomile Flowers in the ſame Manner. For in this Way of Cure we neither know the Nature of the Bark, or of the Flowers, or of the Blood, or of its Motion, which cauſes the Fever to be Quartan. We only know by Obſervation, that in this Age, this ſort of Fever is always carried off by theſe Helps.

6. Therefore, in order to carry off all other Remedies as happily, we muſt change one unknown Body into another unknown Body, which does not belong to any Method or Art; for a known Figure is not only to be given to an unknown Body by help of a known Figure, which Geometry teaches, or Mechanics perform; but the unknown Figures of the Parts of a Body muſt be chang'd into other unknown Parts, or unknown Forces are to be chang'd into other unknown Forces, which Chance ſometimes performs, but Art cannot ſhew it.

7. For it is moſt evident and manifeſt, that neither Blood-letting nor Purging, nor

any other Excretion through the Pores of the Skin, or other Glands, can carry off Fevers, whether continual or intermitting, with the ſame Succeſs as the ſaid *American* Bark or Flowers of Chamomile do an intermitting Fever: And therefore he that would expel continual Fevers with the deſir'd Succeſs, muſt firſt have experienc'd a Remedy as good as the Bark is for driving away Fevers; and therefore the Praiſe of this muſt be reſerv'd to Chance and Fortune, and not to the Art, Sagacity or Deſign of Man.

8. We call that Body unknown to us, not only whoſe Weight and Figure, and Quantity, and Situation, and Quantity of Motion, and Coheſion of Parts, and Forces of Attraction, are unknown to us; but we ſhall alſo call unknown, ſuch an one whoſe Weight and Colour we know, if we compare it with another, (as Gold) but remain ignorant of the Coheſion of its Parts, and attractive Force, if we compare its Parts with the Parts of other Bodies: Thus Lead and Gold are Bodies unknown to us; that is, their inmoſt Nature is not underſtood by us Men. In one Word, that is unknown, all whoſe Relations to other Bodies we are not acquainted with: And therefore no body will ever (unleſs by Chance) change Lead into Gold, if he knows no more of their Natures than we do at preſent; yet thoſe Phy-

ſicians are like the Alchymiſts, who boaſt of curing Diſeaſes whoſe Natures depending upon the Nature of the Bodies cauſing them, are not more, but much leſs known to us than the Nature of Lead or Gold.

Therefore I don't doubt but that I have ſolved this noble Problem, viz. To find a Remedy for a given Diſeaſe.

Jamque opus exegi———

FINIS.

* * *

The Names of PERSONS quoted by Dr. PITCAIRN.

ALEX. Monteith, 186
Ariſtotle, 140, 162, 163
Bellini, 90, 183, 184, 204, 206, 211, 213
Bohnius, 72, 73, 78
Borelli, 68, 70, 71, 77, 78, 132, 133, 134
Boyle, 65, 208
Cæſalpinus, 152
Caſſius, 181, 211
Celſus, 258
Doleus, 109
Etmuller. 77, 78, 175, 182
Euripus, 155
Galen, 33
Guerikius, 65
Harvey, 27, 34, 55, 60, 73
Helmont, 109, 110
Hippocrates, 33, 140, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 155, 157, 158, 159, 160, 162, 216
Hugens, 48, 200
Sir *Iſaac Newton*, 52, 132, 193
Liſter, 75, 250
Lower, 73, 74
Malpighius, 76, 77, 81, 100, 182
Nicholas Steno, 190, 192, 193
Pechlin, 95, 96
Potter, 176
Publius Syrus, 245
Pythagoras, 137
Raymond Vieuſſens, 219
Sanctorius, 59, 120, 186, 196, 197, 201, 202, 205, 225, 226, 227
Servetus, 152
Sylvius, 76, 77, 171, 173, 176, 185, 258
Thurſton, 76, 77
Vepfærus, 173, 174, 185
Wedelius, 72, 78, 109, 110, 124, 130
Willis, 34, 77, 122, 123, 171, 172, 173, 176, 181, 185
Wolſangus, 72, 130
Zacutus, 264.

THE METHOD Of CURING the SMALL-POX:

Written in the Year 1704.

For the Uſe of the
Noble and Honourable Family
OF
MARCH.

By Dr. PITCAIRN.

Printed in the Year MDCCXV.

THE METHOD Of CURING the SMALL-POX.

1. IF a Child, or any Perſon grow ſick, feveriſh, or has a Pain in the Back, or *Slot* of the Breaſt, Loſs of Appetite, Drowſineſs, ſhort Cough, Sneezing, watery Eyes, or ſome of theſe; but always accompanied with ſome Heat, and frequent Pulſe, or Drought. In this caſe Blood is to be taken at the Arm, or with Loch-Leeches; and if the Fever ceaſes not, tho' the Pox appear, let Blood a ſecond or third time. Mean time,

give the Child a Spoonful of Syrup of White Poppies at Night, and in the Night time, alſo till Sleep or Eaſe comes.

2. After the Pox appears, and Fever is gone, then ſteep a Handful of Sheeps Purles in a large † Mutchkin of Carduus-water, or Hyſop-water, or Fountain-water, for 5 or 6 Hours; then pour it off without ſtraining, and ſweeten it with Syrup of red Poppies. Give of this a Spoonful or two, every 4th or 5th Hour, to make the Pox fill, and preſerve the Throat. Always at Night-time, and in the Night, give a Spoonful or two of the Syrup of white Poppies for a Cordial, that keeps down the Fever, and keeps up the Pox.

3. If the Pox run together in the Face (which is the only thing that brings Hazard) uſe the Infuſion of the Purles, and the Syrup of white Poppies oftner than in other Caſes; alſo about the eighth Day from the appearing of the Pox, or a little before that, give the Child to drink of Barley-water, ſweetned with Syrup of white Poppies; this will make the Child ſpit, which ſaves the Child.

4. The Child's Drink may be Milk and Water at other times, or Emulſion, but uſe the firſt rather.

---

† *A Pint Meaſure.*

5. Apply nothing to the Face. Uſe no Wine, or Winiſh Poſſets.

6. If any Looſneſs comes before the 4th Day of the Eruption, ſtop it with Syrup of Poppies, and five or ſeven Drops of liquid Laudanum given now and then till it be ſtopt.

Let the Child's Diet be all along a thin *Bread-Berry* in the Morning, a weak Broth, and ſoft Bread for Dinner, and Milk and Bread at Night, or Sugar-Bisket and Milk, and about the fifth Day from the Eruption, give the Child Water-gruel ſometimes.

Note, If at any time the *Small-Pox* diſappear, with a Raving before the 5th, 6th, or 8th Day from the Eruption, then let Blood again, and apply a large Bliſtering Plaiſter between the Shoulders, and give an Emulſion.

2. If the *Small-Pox* fall down, without raving, then apply a Bliſtering Plaiſter large between the Shoulders, and give an Emulſion, and boyl in a Gill of Water, and as much White or Red Wine, half a Dram or a Dram of Zedoary-Root ſliced, 2 Figgs, and 2 Scruples of Theriac or Diaſcordium; ſweeten it with Syrup of Kermes and white Poppies, each half an Ounce.

give the Child a Spoonful of Syrup of White Poppies at Night, and in the Night time, alſo till Sleep or Eaſe comes.

2. After the Pox appears, and Fever is gone, then ſteep a Handful of Sheeps Purles in a large † Mutchkin of Carduus-water, or Hyſop-water, or Fountain-water, for 5 or 6 Hours; then pour it off without ſtraining, and ſweeten it with Syrup of red Poppies. Give of this a Spoonful or two, every 4th or 5th Hour, to make the Pox fill, and preſerve the Throat. Always at Night-time, and in the Night, give a Spoonful or two of the Syrup of white Poppies for a Cordial, that keeps down the Fever, and keeps up the Pox.

3. If the Pox run together in the Face (which is the only thing that brings Hazard) uſe the Infuſion of the Purles, and the Syrup of white Poppies oftner than in other Caſes; alſo about the eighth Day from the appearing of the Pox, or a little before that, give the Child to drink of Barley-water, ſweetned with Syrup of white Poppies; this will make the Child ſpit, which ſaves the Child.

4. The Child's Drink may be Milk and Water at other times, or Emulſion, but uſe the firſt rather.

---

† *A Pint Meaſure.*

5. Apply nothing to the Face. Uſe no Wine, or Winiſh Poſſets.

6. If any Looſneſs comes before the 4th Day of the Eruption, ſtop it with Syrup of Poppies, and five or ſeven Drops of liquid Laudanum given now and then till it be ſtopt.

Let the Child's Diet be all along a thin *Bread-Berry* in the Morning, a weak Broth, and ſoft Bread for Dinner, and Milk and Bread at Night, or Sugar-Bisket and Milk, and about the fifth Day from the Eruption, give the Child Water-gruel ſometimes.

Note, If at any time the *Small-Pox* diſappear, with a Raving before the 5th, 6th, or 8th Day from the Eruption, then let Blood again, and apply a large Bliſtering Plaiſter between the Shoulders, and give an Emulſion.

2. If the *Small-Pox* fall down, without raving, then apply a Bliſtering Plaiſter large between the Shoulders, and give an Emulſion, and boyl in a Gill of Water, and as much White or Red Wine, half a Dram or a Dram of Zedoary-Root ſliced, 2 Figgs, and 2 Scruples of Theriac or Diaſcordium; ſweeten it with Syrup of Kermes and white Poppies, each half an Ounce.

3. In the End of the Diſeaſe, that is, about the 10th, 11th, 14th, *&c.* Day, after the Eruption; if the Child's Defluxion is groſs, either apply a new Veſicatory, or give often the Spirit of Hart-horn, in Syrup of Violets, or a Vomitor.

Laſtly, When the Pox is blackened ſufficiently, or about the 14th Day from the Eruption, let the Child drink Whey, eat Pottage, *&c.* Broth with Prunes, unleſs the Child's Belly is open enough of it ſelf.

But if the Child is ſo young or unlucky, as not to cough heartily, and force up the Defluxions; or if the Froſt thickens it, apply to the *Slot* of his Breaſt a Pulteſs of Theriac, Diaſcordium, Alkermes, Oyl of Roſemary, and Cinnamon with warm Claret, in a double Linnen Cloath often.

2. And to the Throat apply, in a double Linnen Cloath, a Pulteſs of Cow's Dung boil'd with Milk, and ſoft white Bread: Put a little Brandy to as much as you apply at a time.

3. For the Defluxion alſo give inwardly ſome of this, which has a Dram of *Sperma Cæti*, well mix'd in a Glaſs-Mortar (not a Braſs one) with fine Sugar; to which add

at leiſure Syrup of Violets, or Balſamick, or Poppy Syrup, with ſome Spirit of Hartshorn.

If the Pox was confluent or run together on the Face, then, after the Perſon is recovered, give a Purgative, to bring away the Remainder of the Pox within the Guts.

* * *

FINIS.

BRITISH LIBRARY
30 MAR 74